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JOURNAL OF PALEONTOLOGY

JOSEPH A. CUSHMAN, Editor

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Volume 2 Number 4

JOURNAL OF PALEONTOLOGY

DECEMBER 1928

AMMONITES OF ENORMOUS SIZE FROM THE TEXAS CRETACEOUS

By GAYLE SCOTT and MARCUS H. MOORE
Texas Christian University, Fort Worth, Texas

ABSTRACT

Two species of large ammonites from the Austin Chalk of the Rio Grande region are described, and comparisons of these species are made with some of the large ammonites recorded from other parts of the world.

The Cretaceous of Texas has long been famed for the large numbers of ammonites which many of its beds contain. Some of these have continually attracted the attention of geologists and others by their abundance and large size. Ammonites of a foot and a half, or even two feet, in diameter are not uncommon at many levels.

These fossils are eagerly sought by natural history museums all over the country. In the Cretaceous area of Texas there is scarcely a natural history laboratory of any grade that does not possess one to several specimens.

The two species about to be described occur in considerable abundance in the Austin Chalk of the Rio Grande region, but elsewhere seem to be relatively rare or absent. They surpass all others that the writers have seen in Texas in the great diameter of their spires and in the height and thickness of their whorls. One specimen, (Pl. 36, fig. 3) impossible to extract from its matrix, measured 4 ft. 9 in. in diameter. Many others only slightly smaller were found. These forms thus rival the famous large Senonian ammonites of Europe in size. The Texas forms seem to be somewhat lower stratigraphically

than most of the large ammonites of Europe which have attracted attention, and generically and specifically are different. They belong, however, to a group well represented on that continent.

Many geologists have seen the Texas specimens, and no doubt representatives exist in many collections, but they seem never to have been described or figured, or—so far as literature at hand shows—to have been recorded.

In the summer of 1927 the writers, in making a hurried trip from Eagle Pass to Del Rio, collected and shipped to Fort Worth, the specimen here described as *Parapuzosia americana*. Early in 1928, Moore returned to the locality and collected three specimens of the form to be described as *Parapuzosia bosei*, which in spite of the fact that it escaped notice on the first visit, seems to be the more abundant.

The writers are unable to say from what level in the Austin Chalk the fossils came, but associated with them are the following species—or at least closely allied forms: *Mortoniceras texanum* Roemer, *Barroisiceras dentato-carinatum* Roemer, and *Hemiaster texanus* Roemer.

The relationships of the many Senonian ammonites belonging to the family Desmoceratidae Zittel, emend Spath, and the sub-family Puzosinae Spath,[1] are as yet poorly understood, and the several genera to which these ammonites have been referred are still, in many cases, so poorly defined that it is difficult to use them accurately. The species under consideration are placed in the genus *Parapuzosia* Nowak,[2] emend Spath,[3] for reasons which will be brought out in their descriptions.

The type specimens are at Texas Christian University.

Genus PARAPUZOSIA Nowak

PARAPUZOSIA BOSEI, n. sp.

Plate 36, figs. 1-3; plate 37, fig. 2

Measurements

Diameter	950 mm
Umbilicus	245 mm
Width of last whorl	400 mm
Thickness of last whorl	210 mm

The accompanying illustrations and measurements leave little to

[1] Spath, L. F., "On the Senonian Ammonite fauna of Pondoland", Trans. Royal Soc. S. Africa, vol. 10, pt. iii, 1923.

[2] Nowak, J., "Untersuchungen uber die Cephalopoden der oberen Kreide in Polen", pt. iii, Bull. Acad. Sc. Cracovie, Cl. Sc., Math. et Natur., ser. B: Sc. Nat., Juin 1913, p. 363.

[3] Spath, L. F., Loc. Cit.

say by way of description of this species. The suture, with its short elements, peculiar assymmetrical divisions of the first lateral lobe, and marked shortness of the ventral lobe as compared with the first lateral, is in close agreement with the pattern of *Parapuzosia daubréei* (de Grossouvre), as figured by Nowak,[4] and with the sutures of other forms referred to the genus by Spath.[5] A similar correspondence may be noted in the angle of the unbilical wall. The genus seems to include forms of quite variable whorl section. In section, this species is closest to *P. daubréei* as figured by Nowak.[6]

The sculpture is somewhat different from that of any other species of the genus that the writers know. No fine ribs or tubercles are discernable. The surface of the shell near the umbilicus is marked by low, broad and widely spaced ribs which decrease in prominence toward the venter and on the older whorls, somewhat as in *P. leptophyllia* (Sharpe),[7] but the ribs are broader, further apart, and less conspicuous than in that species.

The venter is smooth and rounded and the conspicuous impressed line marking it is three to five millimeters wide.

The entire septate part of the best specimen is present but the living chamber is broken off just past the last suture.

This species is the largest that the writers have seen from Texas. Mr. Stroman of Eagle Pass spoke of a locality across the river in Mexico where gigantic forms, presumably of this species or the next, occur in great profusion.

Locality.—24.7 miles from Eagle Pass on the Del Rio road. There is a long exposure in the west bank of the creek to the left of the road.

Age.—Santonian? This species is dedicated to the late Dr. Emil Bose.

PARAPUZOSIA AMERICANA, n. sp.

Plate 37, figs. 1, 3

Measurements

Diameter	1030 mm
Umbilicus	270 mm
Width of last whorl	430 mm
Thickness of last whorl	220 mm?

This species differs from the one just described in its more com-

[4] Nowak, J., Loc. Cit., pl. XLIV, fig. 40.
[5] Spath, L. F., Loc. Cit.
[6] Nowak, J., Loc. Cit., pl. XLIII, fig. 32.
[7] Sharpe, D., "Description of the fossil remains of Mollusca found in the Chalk of England", pt. 1, Cephalopoda, p. 48, pl. XXII, Paleontographical Soc. 1853.

pressed whorls, slightly larger umbilicus, and in certain details of its suture.

The whorl section is so different from that of *P. bosei* that it is difficult to include it in the same genus. The outline of the section, however, corresponds closely to that of *P.? icenica* (Sharpe),[8], and only slightly less closely to that of *P. corbarica* (de Grossouvre)[9] species placed in the genus by Spath.[10] Other characters are not out of harmony with criteria thus far given for the identification of the genus.

[8] Sharpe, D., Loc. Cit., pl. XIX, fig. 4.

The suture of the specimen representing the species is not well enough preserved to be completely delineated. It is clearly of the same general type as that figured for *P. bosei*, but differs from it in certain respects. For example, the secondary elements are longer. In the case of the most prominent outside branch of the first lateral lobe one prong extends beyond and over the ventral lobe almost to the depressed line on the venter. This character alone is sufficient to distinguish *P. americana* from the species just described.

The living chamber is more than half a whorl in length, but the last part of it is missing and is indicated only by the mark of its inner margin on the next inner whorl. The entire shell would probably have measured four and one half feet in diameter. The specimen is not well preserved and considerable reconstruction work had to be done before it could be mounted and photographed.

Locality.—Same as that described for *P. bosei.*

Age.—Santonian?

In 1926 the senior writer collected the fragment of a large *Parapuzosia* from the bed of Boulder Creek near Austin. The specimen lay at the foot of a cliff formed of Eagleford shale and capped by Austin Chalk. The fossil is preserved in chalk and consequently is an Austin Chalk ammonite. It is specifically not determinable, but has a whorl

[9] Grossouvre, A. de., "Recherches sur la Craie supérieure, deuxième partie, paleontologie, les ammonites de la Craie supérieure". Mém. carte géol. de la France, pl. XXVII, fig. 1, 1894.

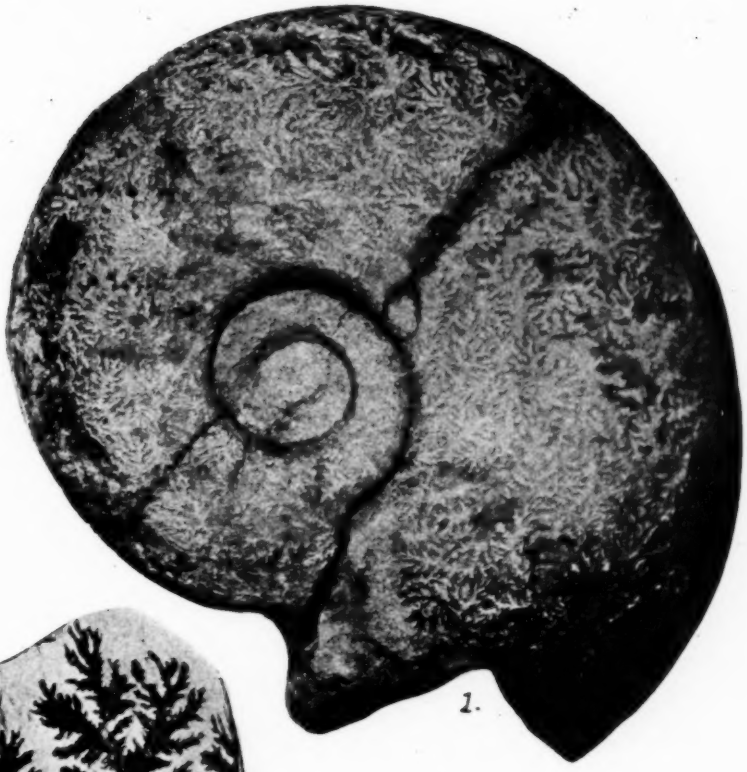
[10] Spath, L. F., Loc. Cit.

EXPLANATION OF PLATE 36

FIG. 1.—*Parapuzosia bosei* n. sp., greatly reduced.

2.—*Parapuzosia bosei* n. sp., showing suture as outlined on the fragment of a specimen of the species. Figure is greatly reduced.

3.—*Parapuzosia bosei* n. sp. Enormous specimen 4 ft. 9 in. in diameter. It was impossible to extract this representative from its matrix.



1.

2.

3.

section similar to that of *P. americana*. The suture, worked from a fragment of the inner whorl, agrees in every detail where comparison is possible. The specimen may be a representative of *P. americana*. On the other hand it may be only a closely related species.

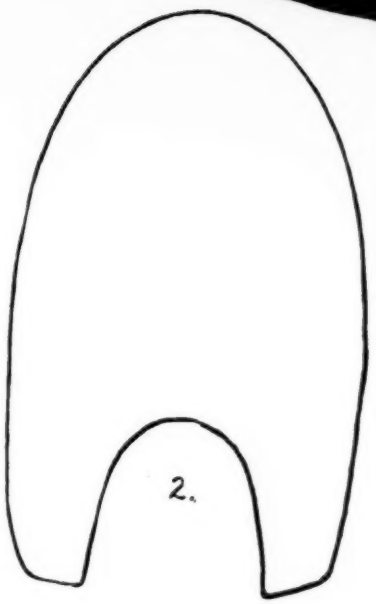
EXPLANATION OF PLATE 37

FIG. 1.—*Parapuzosia americana* n. sp., greatly reduced.

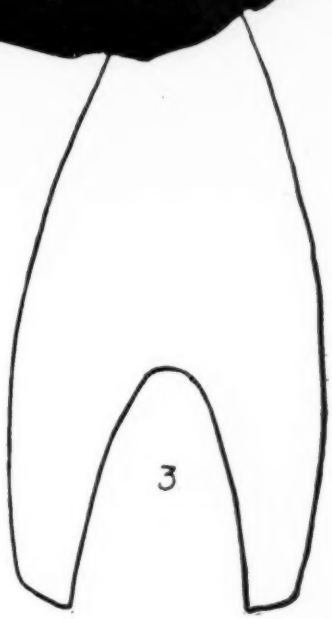
2.—Section of whorl of *Parapuzosia bosei* n. sp. Measurements reduced to one quarter.

3.—Section of whorl of *Parapuzosia americana* n. sp. Measurements reduced to one quarter.

1.



2.



3

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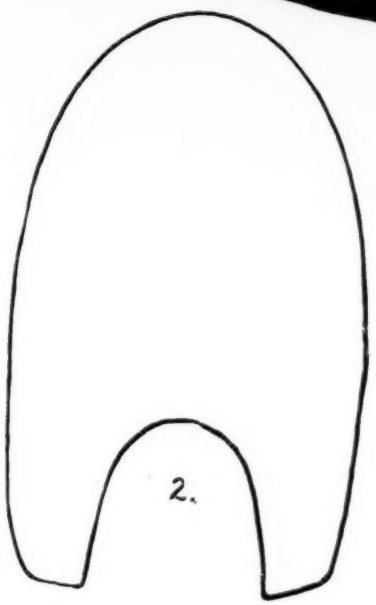
EXPLANATION OF PLATE 37

FIG. 1.—*Parapuzosia americana* n. sp., greatly reduced.

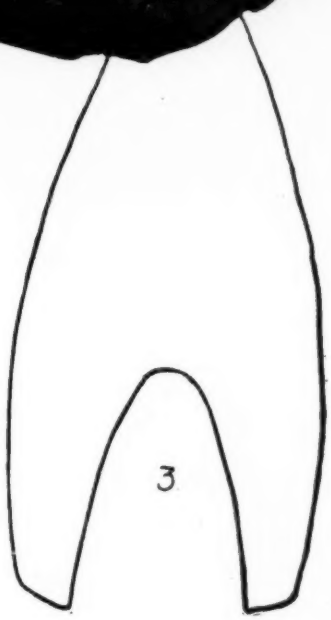
2.—Section of whorl of *Parapuzosia bosei* n. sp. Measurements reduced to one quarter.

3.—Section of whorl of *Parapuzosia americana* n. sp. Measurements reduced to one quarter.

1.



2.



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SOME INDEX FORAMINIFERA OF THE TAMPICO EMBAYMENT AREA OF MEXICO

By MAYNARD P. WHITE
Columbia University, New York

PART II

SYSTEMATIC PART CONTINUED

Family ROTALIIDAE Reuss, 1861

Genus GLOBOROTALIA Cushman, 1927

Genoholotype *Pulvinulina menardii* var. *tumida* BRADY, Geol. Mag., Dec. 2, vol. 4, 1877, p. 294. (Pliocene, New Mecklenburg, Bismarck Archipelago.)
Globorotalia CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 91.

Description.—Test free, rotaloid, all chambers visible on the dorsal side, only those of the last whorl visible on the ventral side, unequally biconvex, umbilicate but not umbonate on the ventral side; peripheral margin angled or carinate; chambers numerous, closely appressed, enlarging gradually or rapidly; walls very finely perforate, smooth or with tubercles, or with limbate sutures on the dorsal side only; aperture a slit, widest in or near the umbilicus and extending part way to the periphery, with or without valvular lip.

GLOBOROTALIA MEMBRANACEA (Ehrenberg)

Plate 38, fig. 1

Planulina membranacea EHRENBERG, Mikrogeologie, 1854, pl. 25, 1A, fig. 41, pl. 26, fig. 43.
Pulvinulina menardii WOODWARD and THOMAS, Geol. and Nat. Hist. Sur. Minn., vol. 3, pt. 1, 1885-92, p. 45, pl. E, fig. 33.
Pulvinulina membranacea CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 608, pl. 21, fig. 10.

Description.—Test biconvex, flattened, longer than broad, with five or six chambers to the last whorl; peripheral margin carinate; chambers enlarging rapidly; walls finely perforate, smooth, with limbate sutures on the dorsal side; aperture a slit in the relatively small umbilicus and extending almost to the periphery.

Length of figured specimen, 0.45 mm.; width, 0.35 mm.; thickness, 0.15 mm.

Occurrence.—This species is a common form from slightly above the base of the Velasco to beyond the limit of that formation as dealt with in this paper.

The figured specimen is from locality No. 23.

GLOBOROTALIA VELASCOENSIS (Cushman)

Plate 38, fig. 2

Pulvinulina velascoensis CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 1, no. 1, 1925, p. 19, pl. 3, fig. 5; Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 608, pl. 21, fig. 9.

Globorotalia velascoensis (CUSHMAN), Journ. Pal., vol. 1, no. 2, 1927, p. 169, pl. 27, figs. 7-9.

Description.—Test plano-convex, dorsal side flat, usually about seven chambers to the last whorl; peripheral margin carinate; chambers enlarging rapidly; walls finely perforate, roughened with low spinose processes, with limbate, slightly raised sutures on the dorsal side; aperture a slit in the large open umbilicus and extending almost to the periphery.

Diameter of figured specimen, 0.6 mm.; thickness, 0.3 mm.

Occurrence.—This is the most characteristic species of the Velasco and occurs as an abundant form from slightly above the base of the formation to beyond the limit of the Velasco as dealt with in this paper.

There is a similar form in the Mexican Eocene with which this species is sometimes confused. A comparison of the two will show differences upon which they may readily be separated.

The figured specimen is from locality No. 23.

Genus GLOBOTRUNCANA Cushman, 1927

Genoholotype *Pulvinulina arca* CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 2, pt. 1, 1926, p. 23, pl. 3, fig. 1. (Upper Cretaceous, Tampico Region.)

Globotruncana CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 91.

Description.—Test free, rotaloid, all chambers visible on the dorsal side, only those of the last whorl visible on the ventral side, the sides flat, convex or concave, umbilicate but not umbonate on the ventral side; peripheral margin with a single or double keel; chambers numerous, closely appressed, enlarging gradually or rapidly; walls finely perforate, somewhat rough with raised limbate sutures on both sides of the test, distinctly beaded; aperture obscured, entering the large umbilicus on the ventral side.

GLOBOTRUNCANA CANALICULATA (Reuss)

Plate 38, fig. 3

Rosalina canaliculata REUSS, Denk. Kais. Akad. Wiss. Math.-Natur. Cl. Wien, vol. 7, 1854, p. 70, pl. 26, fig. 4.

Rosalina marginata ELEY, Geology in the Garden, 1859, p. 196, pl. 9, fig. 16C.

Globigerina linnaeana BURROWS, SHERBORN and BAILEY, Journ. Roy. Mic. Soc., 1890, p. 561, pl. 11, fig. 19.—CHAPMAN, W. Australian G. S. Bull. 72, 1917, p. 44, pl. 11, fig. 103.

Globigerina canaliculata EGGER, Abh. Math.-Phys. Cl. der König. Bay. Akad. Wiss., München, vol. 21, 1902, p. 172, pl. 21, figs. 15-17.

Discorbina canaliculata EGGER, Sitz. Math.-Phys. Cl. der König. Bay. Akad. Wiss., München, 1909-10, p. 33, pl. 3, figs. 1-4, 11-18.

Discorbina linnaeana EGGER, ibid., p. 36, pl. 3, figs. 5-7

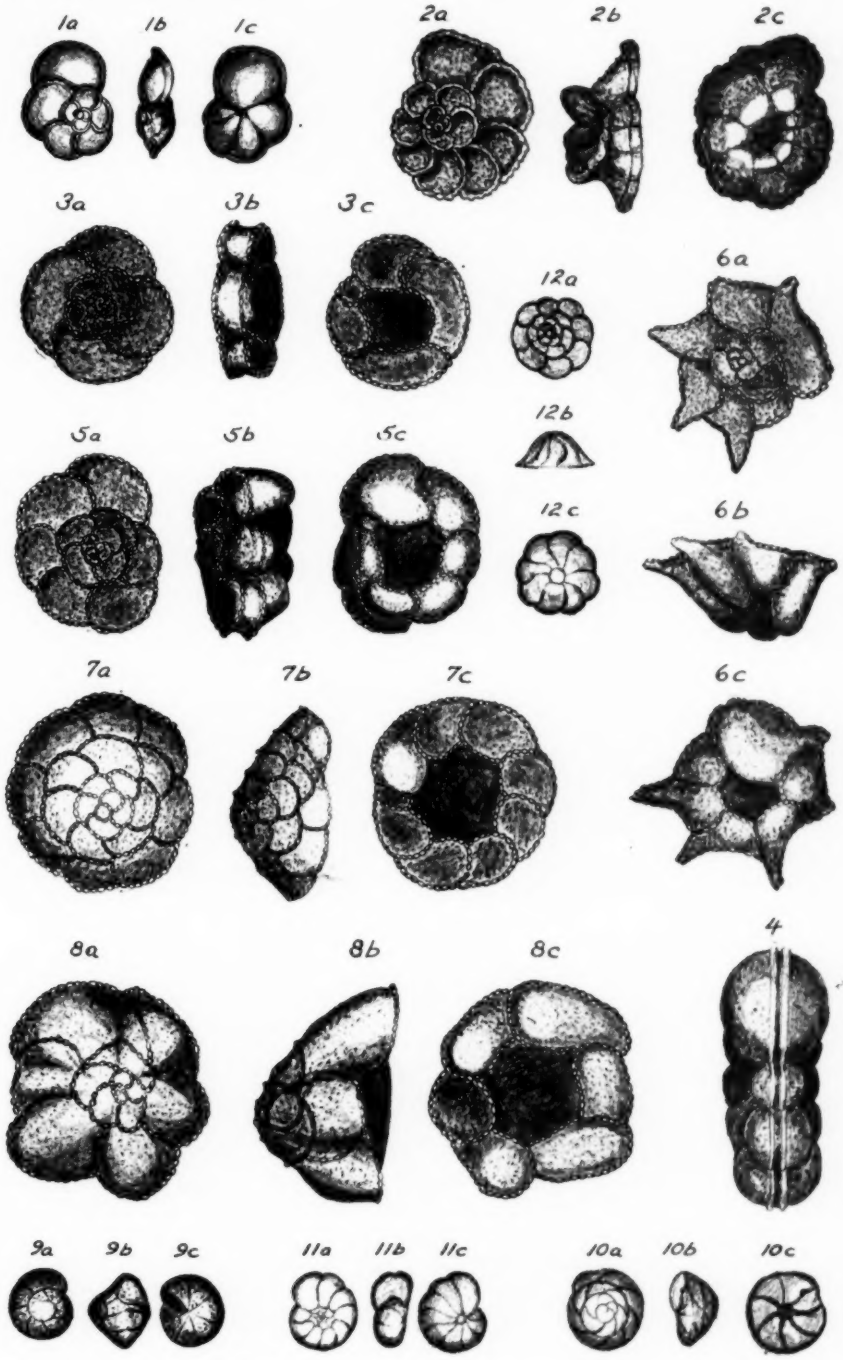
Globotruncana canaliculata CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 2, 1927, p. 116, pl. 23, fig. 11.

Description.—Test flat on both sides; chambers rapidly enlarging; double keel at the outer edges of the margin.

Diameter of figured specimen, 0.6 mm.; thickness, 0.12 mm.

EXPLANATION OF PLATE 38

FIG. 1.—*Globorotalia membranacea*, ×40.
2.—*Globorotalia velascoensis*, ×40.
3.—*Globotruncana canaliculata*, ×40.
4.—A double keeled *Globigerina*, ×60.
5.—*Globotruncana canaliculata* var. *ventricosa*, ×40.
6.—*Globotruncana calcarata*, ×40.
7.—*Globotruncana conica*, ×40.
8.—*Globotruncana conica* var. *plicata*, ×40.
9.—*Rotalia cacalilaoensis*, ×40.
10.—*Rotalia* cf. *partschiana*, ×40.
11.—*Gyroidina anomalinoides*, ×40.
12.—*Gyroidina minuta*, ×40.


1a
1b
1c
2a
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3c
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6a
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5c
12c
6b
7a
7b
7c
6c
8a
8b
8c
4
9a
9b
9c
11a
11b
11c
10a
10b
10c

Occurrence.—This species occurs as a rare form from a little above the base of the San Felipe through the middle of that formation. It becomes abundant in the upper San Felipe and continues as such through the Papagallos and Mendez. In rare instances it is found as a very rare form in the very base of the Velasco, but so seldom that it is best to consider its range as not including any part of the Velasco.

The development of the *Globotruncana* from *Globigerina* through a form like *Globigerina voluta* is so obvious and interesting that I have included among the figures one of the double keeled *Globigerina* like *G. voluta* (pl. 38, fig. 4). As the species best illustrating the transition do not exist in the Tampico region I have used material found in a sample taken from a creek bed, twenty-three miles out of Del Rio on the road to Eagle Pass, Texas. *Globigerina voluta* has with it a variety (pl. 38, fig. 4) differing only in having a double keel appearing on the peripheral margin of some or all of the chambers. These keels, by developing over both surfaces of the test and breaking up into beads, produce the form which Reuss called *Rosalina marginata.* Through the widening of the space between the keels so that they come to occupy the outer edges of the peripheral margin, the various forms of the two keeled *Globotruncanas* were developed.

The figured specimen of *Globotruncana canaliculata* is from locality No. 22.

GLOBOTRUNCANA CANALICULATA var. VENTRICOSA, n. var.

Plate 38, fig. 5

Globigerina marginata HERON-ALLEN and EARLAND, (not *Rosalina marginata* REUSS), Journ. Roy. Mic. Soc., 1910, p. 424, pl. 9, figs. 1-3.

Description.—This form is similar to the preceding except that the ventral side is convex instead of flat.

Diameter of type specimen, 0.6 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19890, from locality No. 22.

Occurrence.—This variety of the species occurs as a rare form from the upper San Felipe through the middle of the Papagallos. It gradually becomes more common until it is an abundant form and then rare again from the upper Papagallos through the middle and upper Mendez.

GLOBOTRUNCANA CALCARATA Cushman

Plate 38, fig. 6

Globotruncana calcarata CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 2, 1927, p. 115, pl. 23, fig. 10.

Description.—Test flat to concave dorsally, convex ventrally, with a single keel; each chamber with a marginal spine.

Diameter of figured specimen, 0.6 mm.; thickness, 0.3 mm.

Occurrence.—This species is a very good guide fossil occurring as an abundant form for a very restricted vertical range at a horizon a little below the top of the Papagallos.

The figured specimen is from locality No. 22.

GLOBOTRUNCANA CONICA, n. sp.

Plate 38, fig. 7

Description.—This form differs from the others in being convex on the dorsal side and flat to concave on the ventral side, with a single keel.

Diameter of type specimen, 0.7 mm.; thickness, 0.4 mm.

Holotype.—Columbia University Paleo. Coll. No. 19891 from locality No. 3.

Occurrence.—This species comes up from the Tamaulipas and is found as a rare form through the lower half of the lower San Felipe. It is common throughout the remainder of the San Felipe, being abundant from there to the top of the middle of the Mendez where it again becomes rare and disappears before reaching the Velasco.

There is a very rare form that differs from this one only in having a double keel.

GLOBOTRUNCANA CONICA var. PLICATA, n. var.

Plate 38, fig. 8

Description.—This form differs from the preceding in being fluted or having folds on the dorsal side, starting at or near the top and widening toward the base, causing the outline as seen from above, to appear fluted or polygonal.

Diameter of type specimen, 0.8 mm.; thickness, 0.55 mm.

Holotype.—Columbia University Paleo. Coll. No. 19929, from locality No. 3.

Occurrence.—This variety of the species occurs as a rare form from a little below the middle portion of the San Felipe and through-

out the remainder of that formation. It is a little less rare in the base of the Papagallos, becoming common in the middle of the Papagallos, and becoming rare and disappearing before the Velasco is reached.

There is a very rare form that differs from this one only in having a double keel.

GLOBOTRUNCANA ROSETTA (Carsey)

Plate 39, fig. 1

Globigerina rosetta CARSEY, U. Texas Bull. 2612, 1926, p. 44, pl. 5, fig. 3.

Description.—This is a biconvex form with a single keel.

Diameter of figured specimen, 0.8 mm.; thickness, 0.45 mm.

Occurrence.—This is the most common form of the genus, coming up from the Tamaulipas. It is abundant from the base of the San Felipe to the top of the Mendez.

Globotruncana arca Cushman differs from *G. rosetta* in having two keels, and it is a comparatively rare form in Mexico. The rare form, differing from *G. conica* in having two keels, was named *G. arca* var. *contusa* by Cushman, but as he did not figure any specimen I am not certain whether or not it would include the rare two keeled form of *G. conica* var. *plicata*.

The figured specimen is from locality No. 3.

Genus ROTALIA Lamarck, 1804

Genotype (designated by GALLOWAY and WISSLER, Journ. Pal., vol. 1, no. 1, 1927, p. 59) *R. (Rotalites) trochidiformis* LAMARCK, Ann. Mus., vol. 5, 1804, p. 184; vol. 8, 1806, pl. 62, fig. 8. (Middle Eocene, Grignon, France.)

Rotalites LAMARCK, ibid., used for fossil species of ***Rotalia.***

Rotalina D'ORBIGNY, Hist. Phys. Nat. Cuba, 1839, Foraminifères, p. 75.

Trochulina D'ORBIGNY, subgenus of *Rotalia*, Ann. Sci. Nat., vol. 7, 1826, p. 274; Model No. 73.

Description.—Test free, trochoid or biconvex, spiral, all whorls visible on the dorsal side, only the last whorl visible on the ventral side (rotaloid); ventral side with umbo or small umbilicus; chambers numerous, closely appressed, enlarging gradually; wall very finely perforate; aperture a slit at the base of the last chamber near the periphery, or an arched slit midway between umbo and periphery; test frequently covered with an exogenus deposit, or ornamented with tubercles, limbate sutures, bosses or costae. The larger species have double septa and interseptal canals.

ROTALIA BECCARIIFORMIS, n. sp.

Plate 39, fig. 2

Rotalia beccarii WRIGHT, (not LINNÉ), Ann. Rep. & Proc. Belfast Nat. Field Club, n. s., vol. 1, 1881, p. 132, pl. 27, fig. 15.

Description.—Test biconvex, peripheral margin broadly rounded; ventral side with umbilicus; sutures limbate, on the ventral side depressed and divided into beads near the umbilicus; the terminal face of the last chamber is large and round.

Diameter of type specimen, 0.5 mm.; thickness, 0.3 mm.

Holotype.—Columbia University Paleo. Coll. No. 19892, from locality No. 30.

Occurrence.—This form is rare from the middle Mendez through the lower portion of the Velasco, after which it becomes more common, until it is quite common before reaching the limit of the Velasco as treated here.

This form has more the shape of a *Planulina* than has *Rotalia beccarii,* is flatter dorsally-ventrally, with a more broadly rounded periphery, and with the aperture nearer the peripheral margin.

ROTALIA BECCARIIFORMIS, var.

Plate 39, fig. 3

Description.—This form of the species differs from the preceding in having small, irregular, thread-like lines radiating from the umbilicus out a short distance over the ventral side of the test, instead of the beads.

Diameter of the type specimen, 0.5 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19893, from locality No. 33.

Occurrence.—This variety of the species is found as a rare form from the upper Papagallos to the basal portion of the Velasco, where it gradually becomes more common until it is quite common near the top of the lower portion of that formation. It is not found as high as the middle portion of the Velasco.

ROTALIA BECCARIIFORMIS, var.

Plate 39, fig. 4

Description.—This variety differs from the preceding, the thread-like lines have become much more prominent and small depressions are scattered about between them. The aperture extends further over the margin of the test and the sutures have become obscured on the ventral side.

Diameter of type specimen, 0.5 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19894, from locality No. 33.

Occurrence.—This variety of the species occurs as a rare form from a little above the base of the Mendez and through the middle portion of that formation. It is common for a short distance in the base of the Velasco but soon becomes rare again and extends above the limit of that formation as treated in this paper.

ROTALIA CACALILAOENSIS, n. sp.

Plate 38, fig. 9

Description.—This species is biconvex with a high trochoid spire; sutures curved on the dorsal side, radial on the ventral side which is umbonate; ornamented with very fine tubercles; aperture unobserved, due to the small size of the test.

Diameter of type specimen, 0.25 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19895, from locality No. 32.

Occurrence.—This species occurs as an abundant form from a little above the base of the Velasco to beyond the limit of that formation as dealt with in this paper.

This species is so small that it is hard to determine its exact character. The figured specimen is rather large for the species.

ROTALIA cf. PARTSCHIANA (d'Orbigny)

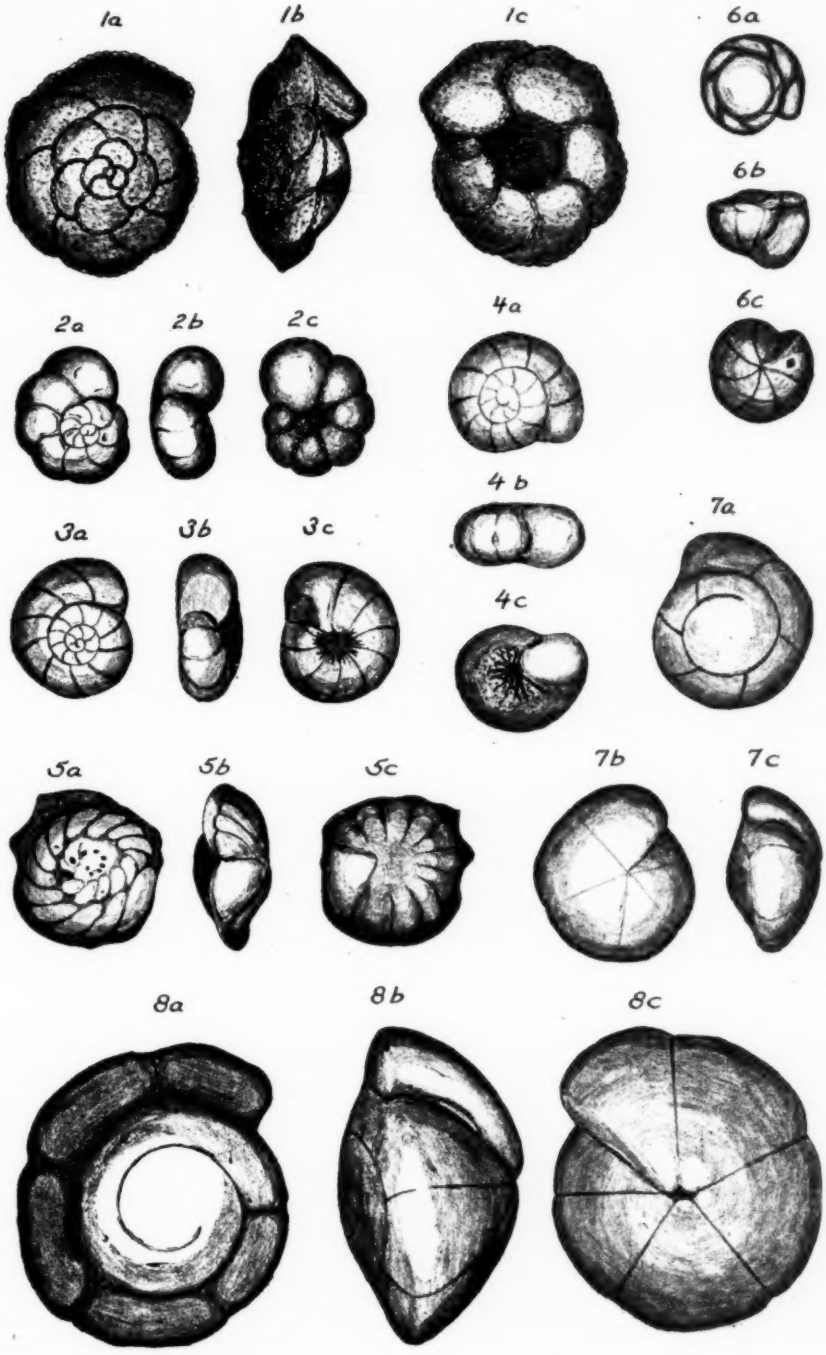
Plate 38, fig. 10

Rotalina partschiana D'ORBIGNY, Foram. Foss. Vienne, 1846, p. 153, pl. 7, figs. 28-30, pl. 8, figs. 1-3.

Pulvinulina partschiana PLUMMER, U. Texas Bull. 2644, 1926 (1927), p. 153, pl. 11, fig. 4.

EXPLANATION OF PLATE 39

FIG. 1.—*Globotruncana rosetta*, ×40.
2.—*Rotalia beccariiformis*, ×40.
3.—*Rotalia beccariiformis*, var., ×40.
4.—*Rotalia beccariiformis*, var., ×40.
5.—*Rotalia velascoensis*, ×40.
6.—*Gyroidina aubangulata*, ×40.
7.—*Gyroidina beisseli*, ×40.
8.—*Gyroidina comma*, ×40.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Description.—Test biconvex with high, trochoid spire; ventral side with umbo; sutures limbate and curved; aperture a rather highly arched slit midway between the umbo and the periphery.

Diameter of figured specimen, 0.3 mm.; thickness, 0.2 mm.

Occurrence.—This species is a rare form found at about the juncture between the lower and middle portions of the Velasco.

This form differs from d'Orbigny's in having a much higher spire.

The figured specimen is from locality No. 2.

ROTALIA VELASCOENSIS (Cushman)

Plate 39, fig. 5

Truncatulina velascoensis CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 1, no. 1, 1925, p. 20, pl. 3, fig. 2; Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 606, pl. 21, fig. 8.

Description.—Test biconvex with a broad, thin keel; ventral side with umbo; sutures on the dorsal side limbate, raised and confluent, with an excavation over the early chambers, sutures slightly depressed on the ventral side, not limbate; aperture a high lunate arch near the periphery.

Diameter of figured specimen, 0.6 mm.; thickness, 0.3 mm.

Occurrence.—This species occurs as a very rare form throughout the Mendez, gradually increasing in the Velasco until it is abundant before reaching the upper limit of that formation as dealt with in this paper.

This form cannot be *Truncatulina*, a synonym of *Cibicides*, as it is finely perforate and the aperture does not extend over the dorsal side.

The figured specimen is from locality No. 5.

Genus GYROIDINA d'Orbigny, 1826

Genotype (designated by CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 4, 1927, p. 190) *G. orbicularis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 278; Model No. 13.

Rotalia (part) of authors.

Description.—Test free, rotaloid, spire low, ventral side deep; chambers numerous, gradually enlarging, closely appressed; sutures shallow, usually not limbate; ventral side sometimes with small umbilicus; wall hyaline, very finely perforate; aperture at the middle of the base of the last chamber or near the periphery; surface usually smooth.

GYROIDINA ANOMALINOIDES, n. sp.

Plate 38, fig. 11

Description.—Chambers embracing so that only a small portion of the early whorls are visible from the dorsal side; small umbo on the ventral side; sutures slightly limbate, curved, last few slightly depressed; periphery rounded; aperture a lunate opening at the middle of the base of the last chamber.

Diameter of type specimen, 0.3 mm.; thickness, 0.15 mm.

Holotype.—Columbia University Paleo. Coll. No. 19896, from locality No. 12.

Occurrence.—This species first makes its appearance, as a slightly better than rare form, a little above the base of the Mendez, and continues through the middle portion. In the upper Mendez it becomes rare and continues beyond the limit of the Velasco as treated in this paper.

GYROIDINA AUBANGULATA (Plummer)

Plate 39, fig. 6

Rotalia soldanii (D'ORBIGNY) var. *aubangulata* PLUMMER, U. Texas Bull. 2644, 1926 (1927), p. 154, pl. 12, fig. 1.

Description.—Usually seven chambers in the last whorl; sutures not limbate, curved, last few on the dorsal side slightly depressed but rest flush; terminal face of the last chamber relatively large; aperture an arched slit at the middle of the base of the last chamber; periphery sharply rounded.

Diameter of figured specimen, 0.4 mm.; thickness, 0.25 mm.

Occurrence.—This species occurs as a rare form from the upper Papagallos through the Mendez, becoming somewhat more common at the base of the Velasco but dying out before reaching the middle portion of the Velasco.

The figured specimen is from locality No. 28.

GYROIDINA BEISSELI, n. sp.

Plate 39, fig. 7

Rotalia sp. BEISSEL, Abh. König. Preuss. Geol. Landesanstalt. N. F., vol. 3, 1891, p. 73, pl. 14, figs. 20-24.

Description.—Dorsal side slightly convex; usually six chambers in the last whorl; sutures not limbate, curved on the dorsal side, radial, meeting in a point and very indistinct on the ventral side, all sutures

flush; periphery rounded; aperture a slit at the middle of the base of the last chamber.

Diameter of type specimen, 0.6 mm.; thickness, 0.35 mm.

Holotype.—Columbia University Paleo. Coll. No. 19897, from locality No. 19.

Occurrence.—This species occurs as a rare form from the middle of the San Felipe through the lower portion of the Velasco.

The curved sutures on the dorsal side will serve to distinguish this species from any of the others with which it might become confused.

GYROIDINA COMMA, n. sp.

Plate 39, fig. 8

Description.—Usually six chambers to the last whorl; sutures not limbate, radial, only the last two slightly depressed; a very small double comma-shaped umbilicus characterizes the species; aperture an arched opening with a slight lip at the middle of the base of the last chamber; periphery sharply rounded.

Diameter of type specimen, 1.1 mm.; thickness, 0.6 mm.

Holotype.—Columbia University Paleo. Coll. No. 19898, from locality No. 23.

Occurrence.—This species occurs as a rare form at the top of the lower portion of the Velasco, becoming somewhat more common before it reaches the limit of that formation as dealt with in this paper.

GYROIDINA CRASSA (d'Orbigny)

Plate 40, fig. 1

Rotalina crassa D'ORBIGNY, Mém. Soc. Géol. France, vol. 4, 1840, p. 32, pl. 3, figs. 7, 8.

Description.—Very deep dorsally-ventrally; usually six chambers to the last whorl; sutures not limbate, radial, only the last two on the dorsal side slightly depressed; aperture at the middle of the base of the last chamber; periphery broadly rounded.

Diameter of figured specimen, 0.53 mm.; thickness, 0.45 mm.

Occurrence.—This species occurs as a rare form from the middle of the Mendez through the lower portion of the Velasco.

The aperture of d'Orbigny's figured specimen differs in character from the Mexican form.

The figured specimen is from locality No. 21.

GYROIDINA EXCOLATA (Cushman)

Plate 40, fig. 2

Truncatulina excolata CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 2, pt. 1, 1926, p. 22, pl. 3, fig. 2.

Description.—Test planoconvex, dorsal side flattened, ventral side broadly convex; irregular costae along the suture lines on the dorsal side with the intermediate areas generally roughened, ventral side smooth with indistinct sutures; periphery angled; aperture a slit at the base of the last chamber near the periphery.

Diameter of figured specimen, 0.55 mm.; thickness, 0.25 mm.

Occurrence.—This species is a very good guide fossil for the Mendez. It is rare in the lower and upper portions of the Mendez but abundant in the middle portion.

This form is very close to the Cretaceous *Rotalia exsculpta* Reuss. In Reuss' species the costae on the dorsal side are more regular and the sutures somewhat depressed and therefore more distinct on the ventral side.

The figured specimen is from locality No. 3.

GYROIDINA FLOREALIS, n. sp.

Plate 40, fig. 3

Description.—Test planoconvex, dorsal side flattened, ventral side deeply convex; sutures on the dorsal side limbate, curved, flush, on the ventral side, radial and indistinct; both sides smooth; periphery with a rather broad, sharp keel; aperture a lunate opening at the base of the last chamber near the periphery.

Diameter of type specimen, 0.8 mm.; thickness 0.5 mm.

Holotype.—Columbia University Paleo. Coll. No. 19899, from locality No. 32.

Occurrence.—This species occurs as a rare form from the uppermost beds of the Papagallos through the lower portion of the Velasco, becoming quite common before reaching the limit of that formation as dealt with in this paper.

GYROIDINA MENDEZENSIS, n. sp.

Plate 40, fig. 4

Description.—Usually seven chambers to the last whorl; sutures not limbate, radial on the dorsal side, curved on the ventral side, indistinct, with the exception of the last one or two on the dorsal side

which are slightly depressed; sutures meeting in a point on the ventral side; a sort of over-hang of the terminal face at the peripheral margin; periphery rounded; aperture in the middle of the base of the last chamber.

Diameter of type specimen, 0.65 mm.; thickness, 0.4 mm.

Holotype.—Columbia University Paleo. Coll. No. 19900, from locality No. 29.

Occurrence.—This species occurs as a rare form in the upper part of the middle portion of the Papagallos, extending from there to the middle of the Mendez as a slightly more common form.

The over-hang of the terminal face and the curved sutures on the ventral side will serve to distinguish this form from any others with which it might become confused.

GYROIDINA MINUTA, n. sp.

Plate 38, fig. 12

Description.—Test small, planoconvex, dorsal side flat, ventral side convex; sutures limbate, flush, curved; umbonate; periphery keeled; aperture a slit in the base of the last chamber near the periphery.

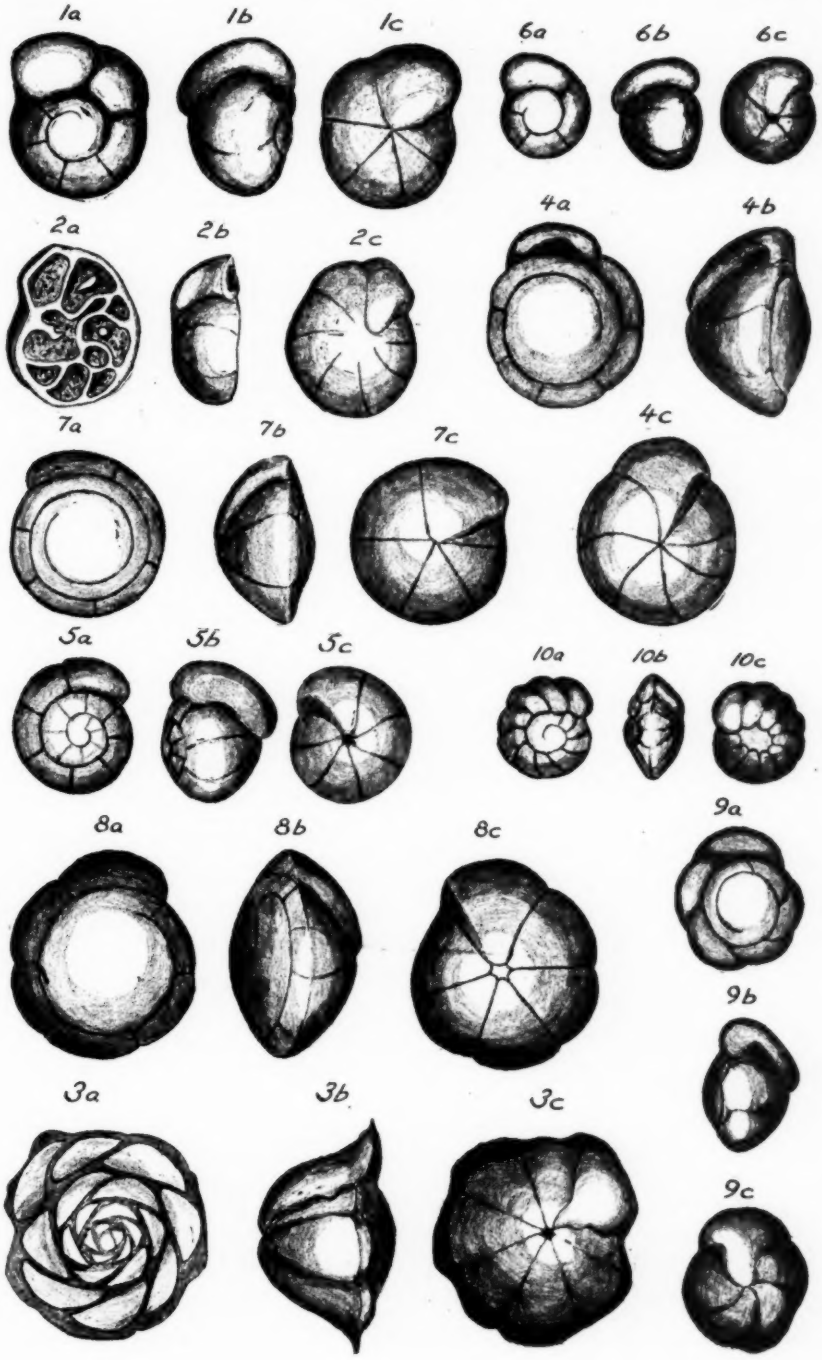
Diameter of type specimen, 0.3 mm.; thickness, 0.15 mm.

Holotype.—Columbia University Paleo. Coll. No. 19901, from locality No. 26.

Occurrence.—This species occurs as a rare form in the middle and upper portions of the Mendez. It is quite abundant at the base of the Velasco, but again becomes rare before reaching the upper limit of that formation as dealt with in this paper.

EXPLANATION OF PLATE 40

FIG. 1.—*Gyroidina crassa*, ×40.
2.—*Gyroidina excolata*, ×40.
3.—*Gyroidina florealis*, ×40.
4.—*Gyroidina mendezensis*, ×40.
5.—*Gyroidina naranjoensis*, ×40.
6.—*Gyroidina nitida*, ×40.
7.—*Gyroidina simplex*, ×40.
8.—*Gyroidina sparksi*, ×40.
9.—*Gyroidina vortex*, ×40.
10.—*Cibicides risseri*, ×40.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5c
10a
10b
10c
8a
8b
8c
9a
9b
3a
3b
3c
9c

GYROIDINA NARANJOENSIS, n. sp.

Plate 40, fig. 5

Description.—Test subglobular; usually seven chambers to the last whorl; sutures somewhat limbate, radial on the dorsal side, very slightly curved on the ventral side, flush; very small umbilicus; periphery broadly rounded; terminal face of the last chamber somewhat flattened; aperture a small lunate opening in the middle of the base of the last chamber.

Diameter of type specimen, 0.5 mm.; thickness, 0.4 mm.

Holotype.—Columbia University Paleo. Coll. No. 19902, from locality No. 23.

Occurrence.—This species occurs as a rare form throughout the greater portion of the lower Velasco, becoming almost common in the middle of the Velasco.

This species differs from *G. crassa* in having limbate sutures and a flattened terminal face on the last chamber.

GYROIDINA NITIDA (Reuss)

Plate 40, fig. 6

Rotalina nitida REUSS, Geogn. Skizze Böhm., vol. 2, pt. 1, 1844, p. 214; Verstein. Böhm. Kreide., 1845-46, p. 35, pl. 8, fig. 52, pl. 12, figs. 8, 20.

Rotalia nitida BEISSEL, Abh. König. Preuss. Geol. Landesanstalt N. F., vol. 3, 1891, p. 71, pl. 14, figs. 14-19.

Description.—Test subglobular; usually five chambers to the last whorl; sutures radial, flush, not limbate; periphery rounded; aperture in the middle of the base of the last chamber; umbilicate.

Diameter of figured specimen, 0.4 mm.; thickness, 0.35 mm.

Occurrence.—This species occurs as a rare form near the top of the lower portion of the Velasco, becoming almost common before reaching the limit of that formation as dealt with in this paper.

The small umbilicus and non-limbate sutures of this species serve to distinguish it from any of those with which it might become confused.

The figured specimen is from locality No. 2.

GYROIDINA SIMPLEX, n. sp.

Plate 40, fig. 7

Description.—Test nearly planoconvex, dorsal side slightly convex, ventral side deeply convex; usually six chambers to the last whorl; sutures radial, flush, indistinct, meeting in a point on the ventral side;

chambers much appressed, long and narrow; periphery somewhat sharply rounded; aperture a long slit in the base of the last chamber, near the periphery.

Diameter of type specimen, 0.6 mm.; thickness, 0.3 mm.

Holotype.—Columbia University Paleo. Coll. No. 19903, from locality No. 29.

Occurrence.—This species is abundant in the middle portion of the Mendez and rare from there through the lower portion of the Velasco.

The radial sutures meeting in a point on the ventral side and the very long, narrow chambers differentiates this species from others much like it.

GYROIDINA SPARKSI, n. sp.

Plate 40, fig. 8

Description.—This species differs from the preceding in having a small umbo; the chambers are relatively broader and indicated by a slight indentation of the periphery at the sutures, which is lacking in the former; the aperture is longer than in the preceding species.

Diameter of type specimen, 0.75 mm.; thickness, 0.4 mm.

Holotype.—Columbia University Paleo. Coll. No. 19904, from locality No. 21.

Occurrence.—This species occurs as a rare form from the uppermost Papagallos to the middle of the lower portion of the Velasco.

This species is named for Mr. D. D. Sparks.

GYROIDINA VORTEX, n. sp.

Plate 40, fig. 9

Description.—Test nearly planoconvex, very slightly convex on the dorsal side, deeply convex on the ventral side; usually six chambers to the last whorl; sutures not limbate, curved, all depressed on the ventral side, last few depressed on the dorsal side; periphery rounded; a depression over the aperture on the terminal face of the last chamber, elongate in the direction of coiling; aperture in the middle of the base of the last chamber.

Diameter of type specimen, 0.5 mm.; thickness, 0.35 mm.

Holotype.—Columbia University Paleo. Coll. No. 19905, from locality No. 2.

Occurrence.—This species is an abundant form from the upper beds of the lower portion of the Velasco to beyond the limit of that formation as dealt with in this paper.

Genus CIBICIDES Montfort, 1808

Genoholotype *C. refulgens* MONTFORT, Conch. Syst., vol. 1, 1808, p. 122, text fig. (Recent, Adriatic.)

Storilus MONTFORT, ibid., p. 131, Genre 33.

Polyxenes MONTFORT, ibid., p. 139, Genre 35. (?)

Truncatulina D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 279; genotype, most typical species, designated by GALLOWAY and WISSLER, Journ. Pal., vol. 1, no. 1, 1927, p. 63, *Cibicides refulgens* MONTFORT.

Description.—Test free, or attached to plants by the dorsal side, rotaloid, spire visible on dorsal side, only the last whorl visible on the ventral side; ventral side usually the more convex, even conical, and umbilicate, dorsal side usually flat; chambers numerous, closely appressed, all alike or the last one much the largest; wall hyaline, coarsely perforate, smooth or with limbate sutures or secondary thickening; aperture a curved slit at the base of the last chamber, on the periphery, extending toward the umbilicus on the ventral side and also continuing on the dorsal side for a short distance along the suture line between the last two whorls, which is characteristic of the genus.

CIBICIDES NARANJOENSIS, n. sp.

Plate 41, fig. 1

Description.—Test biconvex, usually about eight chambers to the last whorl; sutures not limbate, flush, curved, with a small umbo on the ventral side; periphery sharply rounded; characteristic aperture with a lip, the lipped portion small, located on the peripheral margin.

Diameter of type specimen, 0.5 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19906, from locality No. 23.

Occurrence.—This species is found as a common form at the very base of the Velasco. It rapidly becomes rare and dies out before the top of the lower portion of the Velasco is reached.

CIBICIDES RISSERI, n. sp.

Plate 40, fig. 10

Description.—Test unequally biconvex, somewhat more convex on the ventral than on the dorsal side; usually ten chambers in the last whorl; sutures not limbate, curved on the dorsal side, very slightly curved on the ventral side, later sutures depressed; periphery rather

sharply rounded; with an umbo on the ventral side; aperture characteristic, extending toward the umbo on the ventral side and also continuing on the dorsal side for a short distance along the suture line between the last two whorls.

Diameter of type specimen, 0.37 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19907, from locality No. 2.

Occurrence.—This species occurs as a common form through a very restricted vertical range in the middle portion of the Velasco.

This species is named for Senor Armado L. Risser.

Genus KARRERIA Rzehak, 1895

Genotype (monotypic) *K. fallax* RZEHAK, Ann. k. k. Naturhist. Hofmus. Wien, vol. 10, 1895, p. 226, pl. 7, figs. 7, 8. ("Altertier", probably Cretaceous, Bruderndorf, Lower Austria.)

Description.—Test probably attached, early portion coiled in about one whorl, later evolute; six to eight chambers visible, inflated, with wall on the attached side; sutures distinct and moderately deep; wall calcareous, smooth and with large perforations; aperture as in *Cibicides* or terminal, single.

KARRERIA FALLAX Rzehak

Plate 41, fig. 2

Karreria fallax RZEHAK, Ann. k. k. Naturhist, Hofmus. Wien, vol. 10, 1895, p. 226, pl. 7, fig. 8 only.

Description.—As this species is the type of the genus, little need be added to the description unless it is to call attention to the aperture of the Mexican forms. The aperture is a curved slit at the base of the last chamber, on the periphery, extending for a short distance along the suture line over the dorsal and the ventral sides of the test.

Height of figured specimen, 1.2 mm.; width, 0.7 mm.; thickness, 0.45 mm.

Occurrence.—This species occurs as a rare form in the lower and middle portions of the Mendez.

It is quite evident that this form represents a specialization from *Cibicides*.

The figured specimen is from locality No. 3.

Genus PLANULINA d'Orbigny, 1826

Genotype (designated by GALLOWAY and WISSLER, Journ. Pal., vol. 1, no. 1, 1927, p. 66) *P. ariminensis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 280, pl. 14, figs. 1-3; Model No. 49. (Recent, Adriatic Sea, near Rimini.)
Anomalina (part) of authors.

Description.—Test free, planispiral, rather flat or subnautiloid, slightly evolute, the spire visible from both sides; chambers numerous, appressed, curved; sutures simple or limbate; wall hyaline, coarsely perforate; aperture a curved slit at the base of the last chamber on the periphery and extending a short distance on either side, usually on the ventral side.

PLANULINA DAYI, n. sp.

Plate 41, fig. 3

Anomalina complanata BERTHELIN (not REUSS), Mém. Soc. Géol. France, ser. 3, vol. 5, 1880, p. 66, pl. 4, figs. 12, 13.

Description.—Test subnautiloid; spire visible on both sides in the form of rather large umbos; about twelve chambers in the last whorl; sutures rather indistinct with the exception of the last few, flush,

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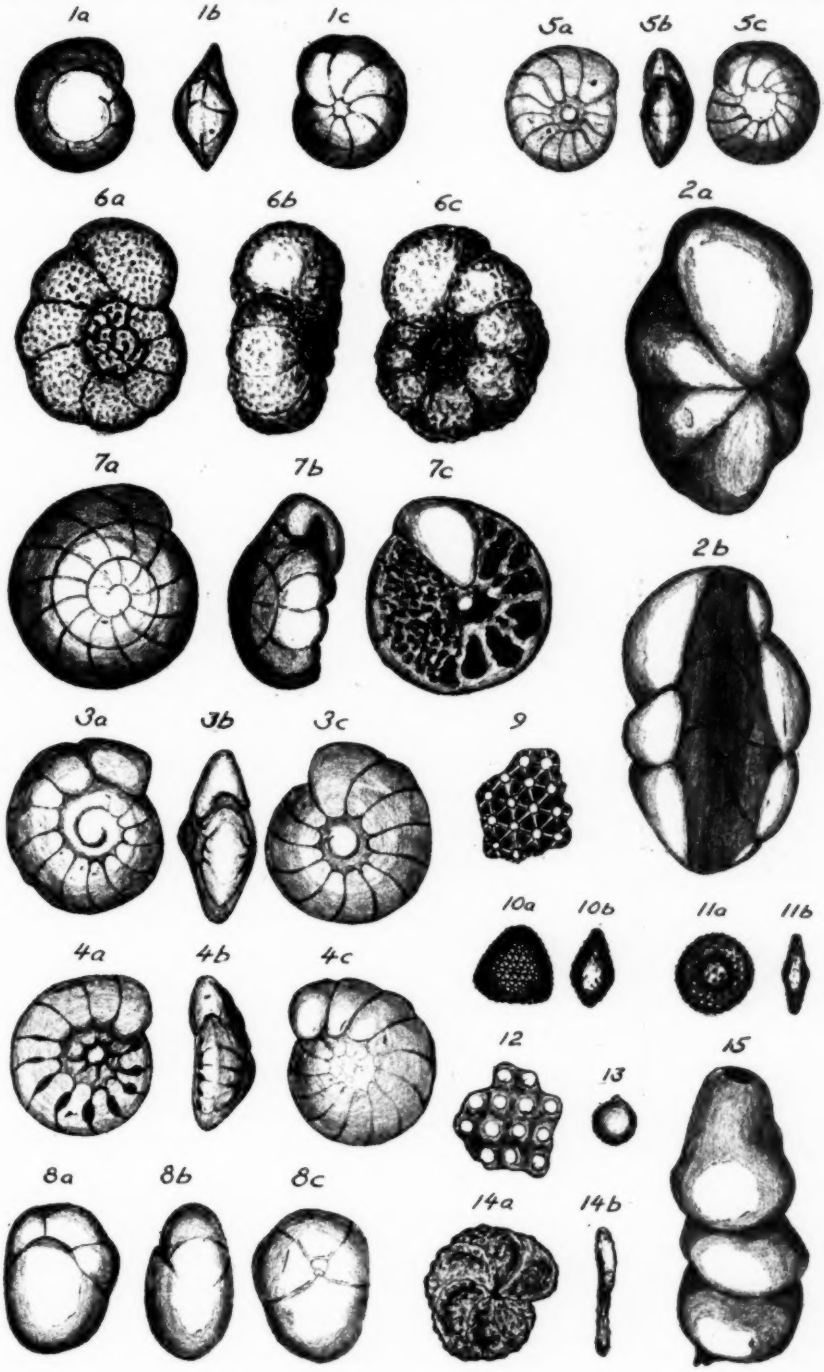
EXPLANATION OF PLATE 41

FIG. 1.—*Cibicides naranjoensis*, ×40.
2.—*Karreria fallax*, ×40.
3.—*Planulina dayi*, ×40.
4.—*Planulina dayi*, var., ×40.
5.—*Planulina dayi*, var., ×40.
6.—*Planulina rubiginosa*, ×40.
7.—*Planulina velascoensis*, ×40.
8.—*Allomorphina allomorphinoides*, ×40.
9.—Surface ornamentation of *Baculogypsina (?) gallowayi* and *B.* (?) *lenticulata*, greatly enlarged.
10.—*Baculogypsina (?) gallowayi*, ×40.
11.—*Baculogypsina (?) lenticulata*, ×40.
12.—Surface ornamentation of *Baculogypsina (?) sphaerica*, greatly enlarged.
13.—*Baculogypsina (?) sphaerica*, ×40.
14.—*Haplophragmoides* sp?, ×40.
15.—*Nodosinella velascoensis*, ×40.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14b

simple; aperture at the base of the last chamber on the periphery, extending a short distance on the ventral side.

Diameter of type specimen, 0.65 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19908, from locality No. 24.

Occurrence.—This species occurs as a rare form from the base of the upper portion of the Papagallos through the lower portion of the Velasco.

As the first two species of *Anomalina* figured by d'Orbigny show no sign of being evolute, with little or no spire showing on either side, it seems best to broaden the description of *Planulina* the little that is necessary to include such species as *P. dayi* rather than to continue to call them *Anomalina*, as has been done in the past. This seems to be necessary as there are species of *Anomalina* sensu stricto.

This species is named for Mr. F. H. Day.

PLANULINA DAYI, var.

Plate 41, fig. 4

Description.—This variety of the species differs from the preceding in having a test which is more convex on the ventral side or flatter on the dorsal side; the sutures are somewhat more pronounced and the spiral can be seen from both sides, rather than being represented by a raised umbo, on the dorsal side the sutures are widened, in some cases leaving a circular depression.

Diameter of type specimen, 0.6 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19909, from locality No. 34.

Occurrence.—This variety of the species occurs as a rare form throughout the Mendez and for the greater portion of the lower Velasco.

PLANULINA DAYI, var.

Plate 41, fig. 5

Description.—This variety of the species has the test shaped very much like the preceding, with a smooth umbo on the ventral side and a slightly raised one on the dorsal side; the sutures are flush and quite indistinct.

Diameter of type specimen, 0.45 mm.; thickness, 0.2 mm.

Holotype.—Columbia University Paleo. Coll. No. 19910, from locality No. 24.

Occurrence.—This variety of the species occurs as a rare to common species in the lower and middle portions of the Mendez.

PLANULINA RUBIGINOSA (Cushman)

Plate 41, fig. 6

Anomalina rubiginosa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 607, pl. 21, fig. 6.

Description.—Dorsal side of the test slightly convex, ventral side with a large umbilicus making it somewhat concave, periphery broadly rounded; coil visible from both sides; sutures depressed and distinct on the ventral side, only slightly depressed and somewhat indistinct on the dorsal side; test covered with peculiar indentations, especially prominent on the ventral side, in some cases obscuring the sutures, less pronounced on the dorsal side; aperture a slit at the base of the last chamber on the periphery and extending for a short distance on the ventral side.

Diameter of figured specimen, 0.75 mm.; thickness, 0.4 mm.

Occurrence.—This species occurs as a rare form in the lower portion of the Velasco.

The figured specimen is from locality No. 32.

PLANULINA VELASCOENSIS (Cushman)

Plate 41, fig. 7

Anomalina velascoensis CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 1, no. 1, 1925, p. 21, pl. 3, fig. 3; Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 607, pl. 21, fig. 7; Journ. Pal., vol. 1, no. 2, 1927, p. 170, pl. 28, fig. 14.

Description.—Ventral side of test nearly flat; dorsal side very broadly rounded; periphery broadly rounded; sutures limbate, flush on the ventral side where as many as three whorls may be seen; on the dorsal side the sutures are raised and very irregular, so that in the more advanced specimens the surface is rough, to such an extent that the suture lines cannot be followed; aperture a slit at the base of the last chamber on the periphery and extending for a short distance on the ventral side.

Diameter of figured specimen, 0.7 mm.; thickness, 0.4 mm.

Occurrence.—This species occurs as a rare form from the upper half of the lower portion of the Velasco and for some distance through the middle portion of that formation.

The figured specimen is from locality No. 32.

Family CHILOSTOMELLIDAE Brady, 1884

Genus ALLOMORPHINA Reuss, 1850

Genotype (monotypic) *A. trigona* REUSS, Denkschr. k. Akad. Wiss. Wien, vol. 1, 1850, p. 380, pl. 48, fig. 14. (Middle Miocene, Austria.)

Description.—Test free, ovate, rotaloid in the young, coiled in a very low spire in the adult, with three or four radially elongate, inflated chambers to a whorl, each tending to embrace the former chambers; wall hyaline, smooth, very finely perforate; aperture an arched slit at the base of the last chamber, on the ventral side of the test near the umbilical region, with slightly flaring lip in most species.

ALLOMORPHINA ALLOMORPHINOIDES (Reuss)

Plate 41, fig. 8

Valvulina allomorphinoides REUSS, Sitz. K. Akad. Wiss. Math.-Nat. Cl., Wien, vol. 40, 1860, p. 223, pl. 11, fig. 6.

Discorbis allomorphinoides CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 606, pl. 20, figs. 18, 19, pl. 21, fig. 5.—PLUMMER, U. Texas Bull. 2644, 1926 (1927), p. 139, pl. 9, fig. 2.

Description.—Test broadly ovate, four chambers of the last whorl visible from the ventral side, one or two of the early chambers, in addition to the four of the last whorl, visible from the dorsal side; sutures indistinct, flush on the dorsal side, very faintly depressed on the ventral side; aperture an arched slit at the base of the last chamber, on the ventral side of the test near the umbilical region, with flaring lip.

Length of figured specimen, 0.55 mm.; width, 0.45 mm.; thickness, 0.35 mm.

Occurrence.—This species occurs as a rare form from the base of the Papagallos to the limit of the Velasco as dealt with in this paper. It is a little less rare in the very base of the Velasco than elsewhere.

The figured specimen is from locality No. 26.

Family TINOPORIDAE Schwager, 1877

Genus BACULOGYPSINA Sacco, 1893

Genotype (monotypic) *Orbitolina sphaerulata* PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 6, 1860, p. 30. (Recent, Rewa, Fiji.)

Tinoporus (not of MONTFORT) CARPENTER, Philos. Trans., 1860, p. 557, pl. 18, figs. 2-10; pl. 21, figs. 5-11.

Baculogypsina SACCO, Bull. Soc. Belge de Geologie, vol. 7, 1893, p. 206.

Description.—Test free, biconvex, lenticular or spherical, with or without spines on the periphery; surface covered with a reticulated pattern of bosses, with or without connecting raised lines of clear shell material; the nucleoconch is rotaloid, which in turn is covered with several layers of supplementary chambers; wall finely perforate; general aperture absent.

BACULOGYPSINA (?) GALLOWAYI, n. sp.

Plate 41, figs. 9, 10

Description.—Test triangular in outline with curved sides, lenticular or biconvex; surface covered with a reticulated pattern of bosses with connecting raised line; aperture absent.

Height of type specimen, 0.3 mm; thickness, 0.17 mm.

Holotype.—Columbia University Paleo. Coll. No. 19911, from locality No. 31.

Occurrence.—This is probably the most valuable single guide fossil of the region, as by means of it alone, the top of the San Felipe may be determined. It is quite common but very hard to detect, due to its size and general poor state of preservation. It is found from the top of the San Felipe for a short distance down into that formation.

Having a siliceous test, which I have taken to be due to replacement, this is another form in which the original character of the material of the test is in doubt. As is the case with all these siliceous forms replaced by silica, I have been unsuccessful in getting a thin section which would give any definite idea as to the internal structure. If this species were a more usual form, one who's specific identification could be made from the literature on foraminifera, the fact that it has been replaced by silica might have gone undetected, it looks so much like any calcareous form. However, the Glomospiras look as if they must be calcareous, instead of arenaceous as they should be, or siliceous as they actually are. It seemed quite likely that these forms I describe under *Baculogypsina* might be Radiolaria, but in looking over the literature I found no Radiolaria with ornamentation similar to this, which however, is so characteristic of *Baculogypsina*. The material is amorphous but not clear silica.

This species is named for Dr. J. J. Galloway.

BACULOGYPSINA (?) LENTICULATA, n. sp.
Plate 41, figs. 9, 11

Description.—Test lenticular, periphery rounded, with a circular raised portion in the center of each side of the test; surface covered with a reticulated pattern of bosses with connecting raised lines; general aperture absent.

Diameter of type specimen, 0.3 mm.; thickness, 0.12 mm.

Holotype.—Columbia University Paleo. Coll. No. 19912, from locality No. 31.

Occurrence.—This valuable species is quite common but hard to detect for a short distance on either side of the top of the San Felipe.

This is another example of replacement. It may also be a Radiolarian.

BACULOGYPSINA (?) SPHAERICA, n. sp.
Plate 41, figs. 12, 13

Description.—Test spherical, sometimes with a slight projection on the surface; surface covered with a reticulated pattern of bosses not connected with raised lines.

Diameter of type specimen, 0.2 mm.

Holotype.—Columbia University Paleo. Coll. No. 19913, from locality No. 31.

Occurrence.—This species, though very hard to detect, is found as an abundant form, for a slightly greater distance to either side of the top of the San Felipe than the preceding species.

As this form is made of amorphous silica which is sometimes clear, and as the bosses are not connected by raised lines and the specimens are smaller than the others, it is quite possible that this may actually be a Radiolarian.

Family LITUOLIDAE Reuss, 1861

Genus HAPLOPHRAGMOIDES Cushman, 1910

Genoholotype *Nonionina canariensis* D'ORBIGNY, Hist. Nat. Îles Canaries, vol. 2, pt. 2, Foraminifères, 1839, p. 128, pl. 2, figs. 33, 34. (Recent, off the Canary Islands.)

Haplophragmoides CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, 1910, p. 99, fig. 149; Bull. 104, pt. 2, 1920, p. 37.

Description.—Test free, planispiral; whorls partially involute; chambers inflated, not labyrinthic; wall finely to coarsely arenaceous, with varying amounts of cement in the different species; aperture a semicircular slit, at, or near the edge of the last chamber and on or near the inner periphery.

HAPLOPHRAGMOIDES sp?

Plate 41, fig. 14

Description.—Test planispiral, very much flattened, round; sutures indistinct, chambers indicated more by depressions in the test than from the sutures; test of very rough amorphous silica; aperture obscured.

Diameter of figured specimen, 0.5 mm.; thickness, 0.07 mm.

Occurrence.—This species occurs as a rare form through practically all the Velasco as treated in this paper.

This is another form which has been replaced by amorphous silica, but due to the roughness of the test it may be safely assumed that it was arenaceous at one time. The sutures are so indistinct that there may be a greater or less number of chambers than has been figured. The state of preservation and inability to determine its exact character makes it advisable to leave it merely as a questionable species.

The figured specimen is from locality No. 13.

Genus TROCHAMMINOIDES Cushman, 1910

Genoholotype *Trochammina proteus* KARRER, Sitz. k. Akad. Wiss. Wien, vol. 52, pt. 1, 1865, p. 494, fig. 8, not figs. 1-7. (Lower Cretaceous, Vienna Basin.)

Trochamminoides CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, 1910, p. 97, figs. 142-144; Bull. 104, pt. 2, 1920, p. 36.

Description.—Test free, glomerate or early portion coiled like a ball of twine or irregularly, followed by two or more coils in a plane; chambers numerous, of varying lengths, with large foramina, and not labyrinthic inside; wall finely arenaceous; aperture simple, large, terminal.

TROCHAMMINOIDES IRREGULARIS, n. sp.

Plate 42, fig. 1

Trochamminoides acervulata FRIEDBERG (not GRZYBOWSKI), Rozprawy Akad. Umiejetnosci Wydzial Math.-Przyrodniczy, ser. 3, vol. 1, dzial A & B, Krakowie, 1901, p. 284, pl. 19-1, fig. 9.

Description.—Test irregular in outline, much flattened, composed of a relatively small number of large chambers; the early portion of the test coiled in an irregular manner, the remainder but little less so; aperture unobserved.

Length of type specimen, 1.05 mm.; width, 0.8 mm.; thickness, 0.25 mm.

Holotype.—Columbia University Paleo. Coll. No. 19914, from locality No. 2.

Occurrence.—This species occurs as a rare form through all the Velasco as treated in this paper.

This species differs from *T. proteus* in its irregularity, and its fewer and larger chambers.

This species, as is very often the case with arenaceous forms, is nearly always distorted by the compacting or differential movement of the enclosing sediment.

TROCHAMMINOIDES PROTEUS (Karrer)

Plate 42, fig. 2

Trochammina proteus KARRER, Sitz. k. Akad. Wiss. Wien, vol. 52, pt. 1, 1865, p. 494, fig. 8, (not figs. 1-7).

Description.—Test almost circular in outline, much flattened, with as many as four or five coils; aperture unobserved.

Diameter of figured specimen, 0.9 mm.; thickness, 0.17 mm.

Occurrence.—This species occurs as a rare form from a short distance above the base of the Velasco past the limit of that formation as dealt with in this paper.

This species is much distorted by pressure.

The figured specimen is from locality No. 7.

Genus NODOSINELLA Brady, 1876

Genotype (designated by MILLER, 1889) *N. digitata* BRADY, Palaeont. Soc. Mono., vol. 30, 1876, p. 102, pl. 7, figs. 1-3. (Middle Permian, Tunstall Hill, Durham, England.)

Description.—Test free, straight or curved, subcylindrical; chambers numerous, uniserial, closely or loosely appressed, frequently unequal in size, gradually enlarging; wall finely arenaceous, thick, vesiculose, but not filling the chamber cavity with labyrinthic structure; aperture terminal, simple, large.

NODOSINELLA VELASCOENSIS Cushman

Plate 41, fig. 15

Nodosinella velascoensis CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 583, pl. 20, fig. 9.

Description.—Test straight, compressed, loosely appressed, each chamber overlapping the previous one unequally, so that in side view the sutures are oblique; wall smooth; aperture terminal, facing toward the more overlapping side of the test.

Length of figured fragment, 1.15 mm.; width, 0.45 mm.; thickness, 0.35 mm.

Occurrence.—This species occurs as a rare form throughout the Velasco as dealt with in this paper.

Generally only fragments of this species are found, and they are usually distorted.

The figured specimen is from locality No. 30.

Family VERNEUILINIDAE Cushman, 1927

Genus VERNEUILINA d'Orbigny, 1840

Genotype (monotypic) *V. tricarinata* D'ORBIGNY, Mém. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 38, pl. 4, figs. 3, 4. (Upper Cretaceous, Paris Basin.)

Description.—Test free, spiral, typically pyramidal, usually conical; chambers three to a whorl, closely appressed or inflated; wall finely or coarsely arenaceous; aperture a slit at the base of the last chamber, nearly transverse to the axis of the test, with or without a raised rim.

VERNEUILINA BRONII Reuss

Plate 42, fig. 3

Verneuilina bronii REUSS, Verstein. Böhm. Kreide, 1845-6, p. 38, pl. 12, fig. 5; Haidinger's Naturw. vol. 4, 1850 (1851), p. 40, pl. 4, fig. 2.—EGGER, Abh. Math.-Phys. Cl. der König. Bay. Akad. Wiss., München, vol. 21, 1902, p. 39, pl. 4, figs. 11-13; Bericht 20, Naturwiss. Ver. zu Passau für 1905-1907, 1908, p. 20, pl. 3, fig. 4.

Verneuilina sp? ELEY, Geology in the Garden, 1859, p. 197, pl. 12, fig. 5.

Description.—Test pyramidal, chambers closely appressed; wall finely arenaceous; aperture a slit at the base of the last chamber, without a raised rim.

Height of figured specimen, 0.5 mm.; greatest width at apertural end, 0.5 mm.; depth at apertural end, 0.5 mm.

Occurrence.—This species occurs as a common form in the upper part of the upper portion of the Papagallos and for a short distance in the base of the Mendez, and as little better than rare from there to the limit of the Velasco as treated in this paper.

The figured specimen is from locality No. 28.

VERNEUILINA CONICA, n. sp.

Plate 42, fig. 4

Description.—Test conical, apertural end flat; chambers closely appressed and irregular; sutures indistinct; wall finely arenaceous; aperture a slit at the base of the last chamber, without raised rim.

Diameter of type specimen, 0.27 mm.; height, 0.45 mm.

Holotype.—Columbia University Paleo. Coll. No. 19915, from locality No. 30.

Occurrence.—This species occurs as a rare to common form from the top of the lower portion of the Velasco to beyond the limit of that formation as dealt with in this paper.

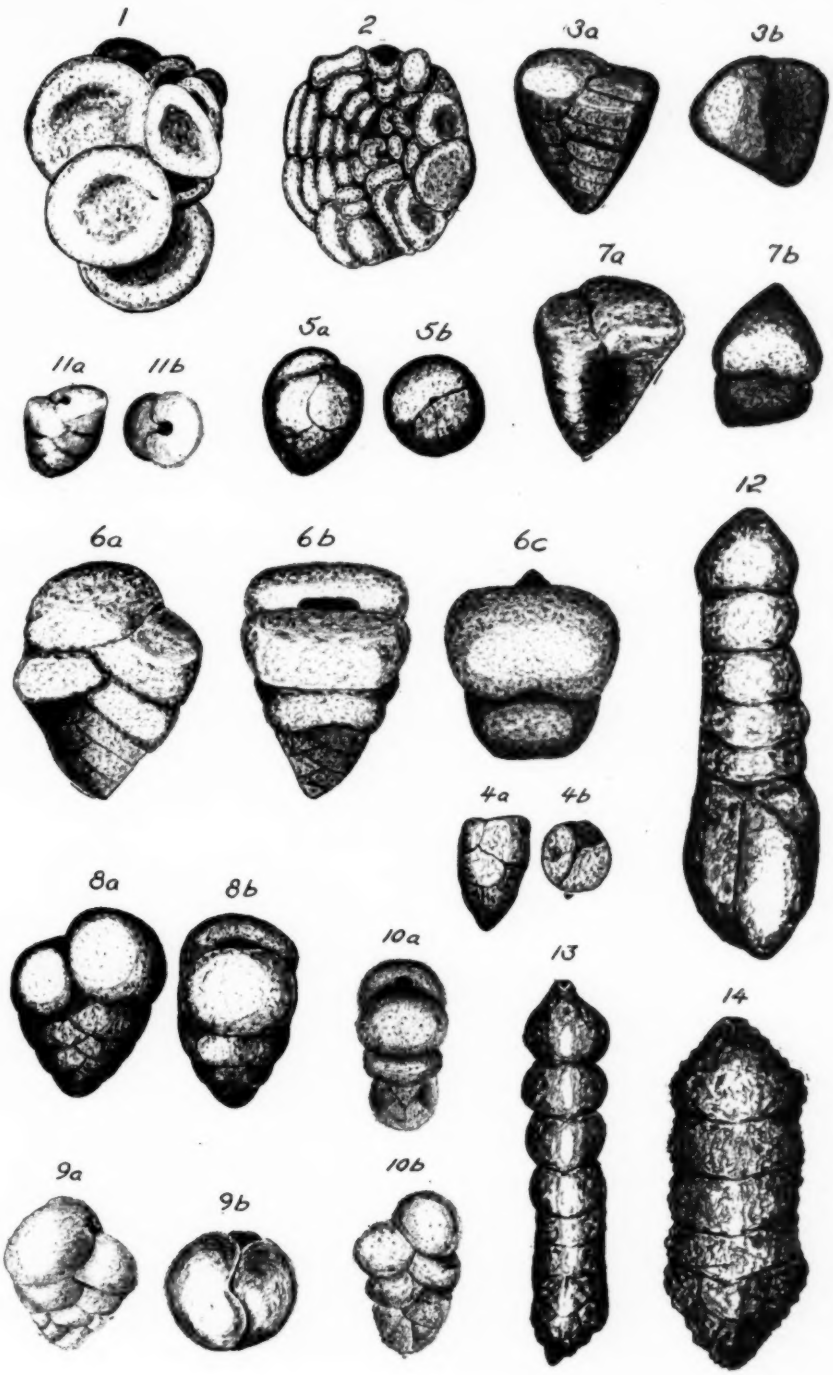
VERNEUILINA ROTUNDA, n. sp.

Plate 42, fig. 5

Verneuilina sp? CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 587, pl. 16, fig. 17.

EXPLANATION OF PLATE 42

FIG. 1.—*Trochamminoides irregularis*, ×40.
2.—*Trochamminoides proteus*, ×40.
3.—*Verneuilina bronii*, ×40.
4.—*Verneuilina conica*, ×40.
5.—*Verneuilina rotunda*, ×40.
6.—*Gaudryina laevigata*, ×40.
7.—*Gaudryina laevigata* var. *pyramidata*, ×40.
8, 9.—*Gaudryina retusa*, ×40.
10.—*Gaudryina spissa*, ×40.
11.—*Gaudryina trochoides*, ×40.
12.—*Clavulina amorpha*, ×40.
13.—*Clavulina trilatera*, ×24.
14.—*Clavulina trilatera* var. *aspera*, ×40.


1
2
3a
3b
7a
7b
11a
11b
5a
5b
12
6a
6b
6c
4a
4b
8a
8b
10a
13
14
9a
9b
10b

Description.—Test conical, rounded; sutures somewhat indistinct; wall finely arenaceous; aperture a lunate slit at the base of the last chamber, without raised rim.

Diameter of type specimen, 0.4 mm.; height, 0.5 mm.

Holotype.—Columbia University Paleo. Coll. No. 19916, from locality No. 34.

Occurrence.—This species occurs as little better than a rare form throughout the Mendez and for some distance in the lower portion of the Velasco.

Genus GAUDRYINA d'Orbigny, 1839

Genotype (designated by CUSHMAN, Bull. U. S. Nat. Mus., 71, pt. 2, 1911, p. 62) *G. rugosa* D'ORBIGNY, Hist. Phys. Pol. Nat. Cuba, 1839, Foraminifères, p. 109, no species; Mém. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 43, pl. 4, figs. 20, 21. (Top of the Upper Cretaceous, Meudon, France.)

Description.—Test free, elongate; early chambers triserially spiral, later ones biserial; wall arenaceous; aperture a transverse slit at or near the base of the last septal face, or round, often with raised border.

GAUDRYINA LAEVIGATA Franke

Plate 42, fig. 6

Gaudryina laevigata FRANKE, Zeitschr. deutch. geol. Ges., vol. 66, 1914 (1915), p. 431, pl. 27, figs. 1, 2.—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 587, pl. 17, fig. 1.

Gaudryina sp? CUSHMAN, Bull Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 588, pl. 16, fig. 11.

Description.—Triserial portion of the test trihedral with sutures distinct but very slightly depressed; biserial portion irregularly foursided, chambers few or many, somewhat higher than the early chambers with depressed sutures; wall smooth; aperture a long, low, somewhat arched opening at the base of the inner margin of the last-formed chamber.

Height of figured specimen, 0.9 mm.; greatest breadth of apertural end, 0.65 mm.

Occurrence.—This species occurs as a rare form through the upper portion of the Papagallos to the middle of the Velasco. It is more common in the Velasco than in the other formations.

As Cushman suggests, I feel that the two species he figures are the

same, differing only in size. The larger form, such as I have figured, may have as many biserial chambers as the smaller.

The figured specimen is from locality No. 3.

GAUDRYINA LAEVIGATA var. PYRAMIDATA Cushman

Plate 42, fig. 7

Gaudryina laevigata var. *pyramidata* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 587, pl. 16, fig. 8.

Description.—This variety differs from the preceding in having concave rather than convex sides in the triserial portion of the test.

Height of figured specimen, 0.6 mm.; greatest width of apertural end, 0.4 mm.; depth of apertural end, 0.5 mm.

Occurrence.—This variety of the species occurs as a rare form in the Velasco only.

The figured specimen is from locality No. 30.

GAUDRYINA RETUSA Cushman

Plate 42, figs. 8, 9

Gaudryina retusa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 588, pl. 16, fig. 10.

Description.—Test stout, nearly circular in outline as seen from above; sutures depressed in the later portion so that the biserial chambers are distinct, in adult forms the triserial portion is relatively small and indistinct; wall smooth, made up of calcareous material principally; aperture a somewhat arched slit at the base of the inner margin of the last-formed chamber.

Height of adult specimen, 0.7 mm.; depth at apertural end, 0.6 mm.; width at apertural end, 0.45 mm.

Occurrence.—This species occurs as a rare form from the bottom of the middle portion of the San Felipe to the top of the lower portion of the Velasco.

A young specimen has been figured also, to show the triserial portion of the test.

The figured specimens are from locality No. 28.

GAUDRYINA SPISSA Berthelin

Plate 42, fig. 10

Gaudryina spissa BERTHELIN, Mém. Soc. Géol. France, ser. 3, vol. 1, mém. 5, 1880, p. 24, pl. 1, fig. 7.

Gaudryina pupoides CHAPMAN (not D'ORBIGNY), W. Australian G. S. Bull. 72, 1917, p. 21, pl. 2, fig. 20.

Description.—Triserial portion bluntly trihedral, sutures very little depressed, biserial portion broadly oval with sutures considerably depressed; wall smooth; aperture a circular opening at the base of the inner margin of the last-formed chamber.

Height of figured specimen, 0.65 mm.; width at apertural end, 0.35 mm.; depth at apertural end, 0.4 mm.

Occurrence.—This species occurs as a rare form from the uppermost beds of the lower portion of the Velasco to the limit of that formation as dealt with in this paper.

The figured specimen is from locality No. 30.

GAUDRYINA TROCHOIDES Marsson

Plate 42, fig. 11

Gaudryina crassa var. *trochoides* MARSSON, Mitth. Nat. Ver. Neu-Vorpommern u. Rügen, vol. 10, 1878, p. 158, pl. 3, fig. 27.—EGGER, Abh. Math.-Phys. Cl. der König. Bay. Akad. Wiss., München, vol. 21, 1902, p. 36, pl. 4, figs. 25, 26.

Description.—Test conical, rounded on the apical end, flattened on the apertural end; sutures flush; wall smooth; aperture at the base of the last septal face, extending back as a circular opening.

Diameter of figured specimen, 0.3 mm.; height, 0.3 mm.

Occurrence.—This species occurs as a rare form from a little above the base of the Velasco to beyond the limit of that formation as dealt with in this paper.

This species differs considerably from *G. crassa* Karrer (Jahrb. k. k. geol. Reichsanstalt, vol. 20, 1870, p. 166, pl. 1, fig. 4).

The aperture of the Mexican form is somewhat different from that shown in Marsson's figures, but as other forms of *Gaudryina* as well as this one, show the different stages in the development of the round from the slit-like aperture, I have not felt it to be of sufficient value to make a different species.

The figured specimen is from locality No. 30.

Genus CLAVULINA d'Orbigny, 1826

Genotype (designated CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 2, 1911, p. 72) *C. parisiensis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 268, Model No. 66. (Eocene, Mouchy-le-Chatel, near Paris.)

Description.—Test free, elongate, cylindrical or angular; chambers numerous, closely to somewhat loosely appressed, in early portion of the test triserially arranged, in the middle portion biserial, usually

absent, and in the later portion uniserial; wall arenaceous, usually smooth; aperture terminal, round, with or without neck, and with or without tooth.

CLAVULINA AMORPHA Cushman

Plate 42, fig. 12

Clavulina amorpha CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 589, pl. 17, fig. 5.

Description.—Early portion of the test increasing rather rapidly in diameter, the periphery rounded but triangular in cross-section, followed abruptly by the uniserial portion, in which the chambers are circular in cross-section and the diameter is considerably less than in the preceding triserial portion; wall finely arenaceous, smoothly finished; sutures rather indistinct; aperture simple, round, terminal.

Height of figured specimen, 1.8 mm.; diameter of biserial portion, 0.45 mm.; greatest width of triserial portion, 0.55 mm.

Occurrence.—This species occurs as a rare form from the upper Papagallos to the limit of the Velasco as treated in this paper. It is a little less rare in the Mendez than in the other two formations.

The figured specimen is from locality No. 3.

CLAVULINA TRILATERA Cushman

Plate 42, fig. 13

Clavulina trilatera CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 588, pl. 17, fig. 2; Journ. Pal., vol. 1, no. 2, 1927, p. 149, pl. 28, fig. 1.

Description.—Test triangular in cross-section though becoming rounded in the later portion, triserial portion relatively small; early sutures indistinct and very slightly depressed, later ones distinct and much depressed; wall coarsely arenaceous but rather smoothly finished; aperture terminal, simple, round, at the end of a short neck.

Length of figured specimen, 2.3 mm.; greatest width, 0.6 mm.

Occurrence.—The range and occurrence of this species is practically the same as the preceding.

The figured specimen is from locality No. 3.

CLAVULINA TRILATERA var. ASPERA Cushman

Plate 42, fig. 14

Clavulina trilatera var. *aspera* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, 1926, p. 589, pl. 17, fig. 3.

Description.—This form is stouter than the preceding, retains its trihedral form throughout, its sides tend to more concavity; the test is in general more coarsely arenaceous and roughly finished.

Length of figured specimen, 1.4 mm.; greatest width, 0.55 mm.

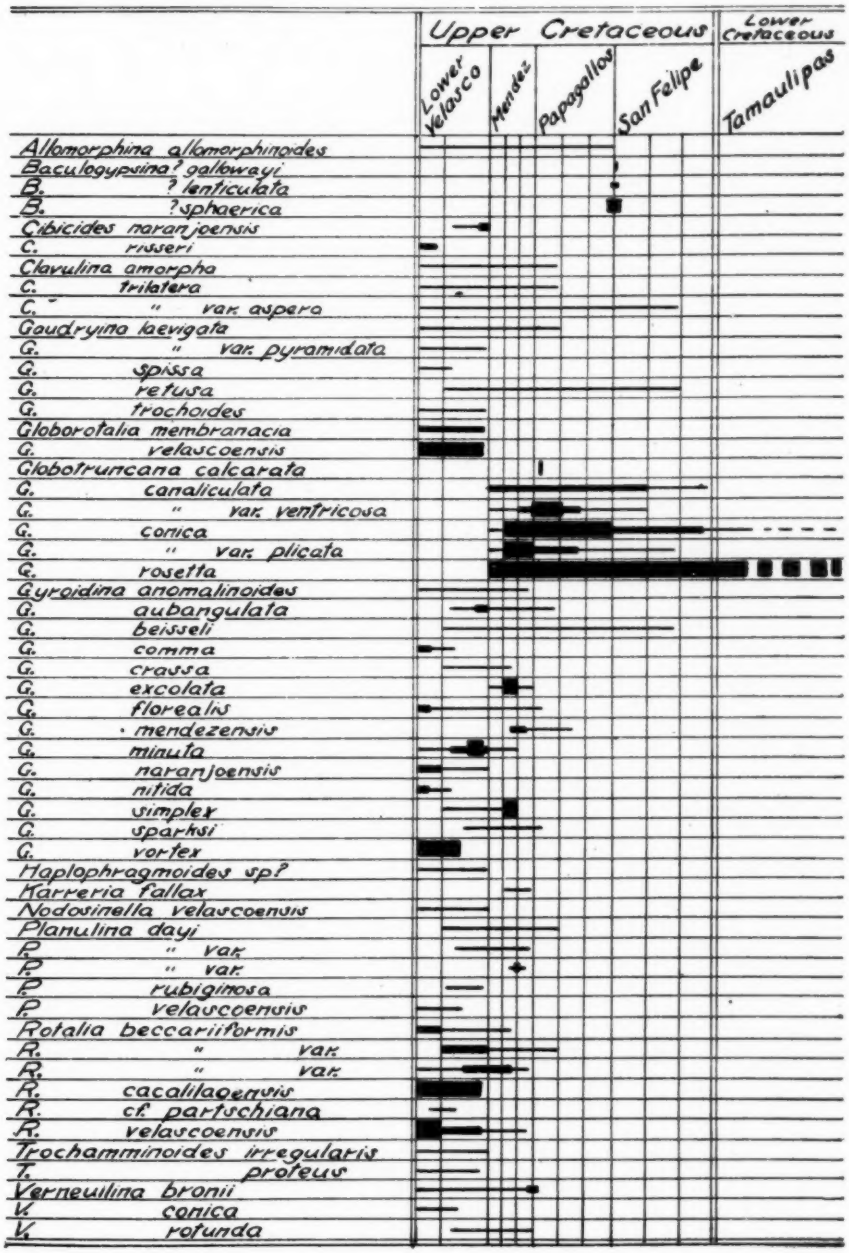
Occurrence.—This variety of the species has a longer range than the preceding, it being found as low as the base of the middle portion of the San Felipe. It is rare throughout its range.

The figured specimen is from locality No. 30.

(TO BE CONTINUED)

TABLE SHOWING THE RANGES

Width of Line Showing Relative Abundance



SOME PENNSYLVANIAN OSTRACODES FROM THE HENRIETTA FORMATION OF EASTERN MISSOURI

By J. Brookes Knight

Part II

Super-family CYPRIDACEA

Family BAIRDIIDAE

Genus BAIRDIA McCoy

This ubiquitous genus is well represented in my collections, there being nine species all distinct and not intergrading. Members of the genus would no doubt be more valuable than they are to the practical stratigrapher were it not for the fact that their generic characters are so very much more marked and conspicuous than the specific that the finer specific discrimination is often difficult to make. It has often been said that "all Bairdias look alike." This difficulty is however more apparent than real and close and critical comparison of good material soon shows up distinctions that are specifically constant and with little practice are readily recognized.

Such discrimination has not always been practiced and there is considerable difficulty in properly referring forms to the more or less composite species of the older authors.

BAIRDIA MOOREI Knight, n. sp.

Plate 43, figs. 1 *a-c*

Dorsal outline of the larger (left) valve rather sharply arched and quite thick over the hinge-line, falling away from the posterior end of the hinge obliquely in a nearly straight line with an indistinct upward tendency at the bluntly acuminate posterior beak. The

ventral line curves gently downward and forward flattening somewhat for the middle half of its length and curving smoothly and gently upward to meet the rather narrowly rounded anterior end. The antero dorsal slope is very slightly concave. The smaller right valve has a narrower outline and a gently convex to flat hinge-line which is about half the length of the carapace. The posterior end of the hinge is more definitely angled than that of the left valve and the posterior beak is sharper and more projecting. The antero-dorsal line follows closely the outline of the left valve but continues to the anterior end more straightly forming a sub-angular juncture with it. The ventral curve is gentle but has a marked re-entrant sinuosity slightly back of the middle. The overlap of the left valve is distinct except at the anterior end where the left valve extends only slightly beyond the right. It is most pronounced in the sub-triangular area above the hinge-line and along the sinuosity of the ventral margin of the right valve where it is almost angular. The outline when viewed from above is lanceolate with smoothly rounding sides. The greatest thickness is at about the middle. In end view the greatest thickness is somewhat below the middle.

This form resembles *B. beedei* Ulrich and Bassler as to general proportions and outline but differs in being more extended anteriorly and in the more marked and almost angular overlap in the ventral sinuosity of the right valve.

The dimensions of the two perfect specimens are:

Length		1.45 mm.	1.43 mm.
Height	R. V.	.72 mm.	.70 mm.
	L. V.	.86 mm.	—
Width		.65 mm.	—

Common but not abundant in the upper Fort Scott limestone at locality 38, and 2. A somewhat doubtful specimen was noted from locality 9.

This specimen is named for Dr. Raymond C. Moore of the University of Kansas, State Geologist of Kansas.

BAIRDIA AURICULA Knight, n. sp.

Plate 43, figs. 3 *a*, *b*

Outline in side view sub-ovate. The larger (left) valve is a little over one and one half times as long as high. Dorsal outline roundly arched with the highest point about midway between the ends Pos-

terior dorsal slope straight from rounded central portion to posterior end of the hinge-line over which a low obtuse curve is formed and below which the margin falls away obliquely backwards to the rounded protruding posterior beak. From the beak the ventral margin passes downward and forward for a short distance meeting the straight ventral portion evenly. The anterior end is high and broadly rounded with a slight upward obliquity. The rather short dorso-anterior margin is straight and blends smoothly with the anterior end. The smaller (right) valve has a narrower outline but except dorsally follows the outlines of the left quite closely. There is an obscure and broad re-entrant concavity along the dorsal line in front of the middle. The hinge-line is comparatively long being about seventy percent of the total length and is gently and broadly arched. The left valve overlaps only slightly and extends an appreciable distance beyond the right only above the hinge-line.

This species differs from *B. moorei* in its greater relative height, its more rounded outlines, particularly that of the anterior end, in its flatter ventral line and its longer hinge-line. It differs in much the same respects from *B. beedei.* From *B. seminalis* by its straighter ventral line, rounder anterior, less rounded post-dorsal line and greater size.

The dimensions are:

Length		1.10 mm.
Height	L. V.	.70 mm.
	R. V.	.65 mm.

Rare in the Upper Fort Scott limestone at locality 38.

BAIRDIA SEMINALIS Knight, n. sp.

Plate 43, figs. 2 *a-d*

Outline of the larger (left) valve sub-oval, the entire carapace having a seed-like aspect. Dorsal outline roundly curved, slightly flattened on the antero-dorsal and less so on the post-dorsal slope. No angulation over the post-dorsal end of the hinge. Posterior beak bluntly angular but not conspicuous. Ventral outline roundly and gently curved for its posterior three quarters and more abruptly upward to the somewhat more sharply rounded anterior end. Outline when viewed from above broadly lanceolate and gently convex, the broadest point being about mid-way. The outline of the smaller (right) valve is considerably narrower and sub-oblong. The hinge-line is comparatively short being about fifty-five percent of the total

length. The dorsal margin of the right valve is flatly arched with a backward slope along the hinge with a steeply rounded post-dorsal and more gradual antero-dorsal slope. The anterior end is somewhat drawn out. The overlap of the left valve is rather pronounced, particularly along the dorsal line. It is even more conspicuous than usual ventrally. The produced anterior end of the right valve however extends forward almost as far as that of the left.

This small *Bairdia* is easily differentiated from any Carboniferous form with which I am familiar by its small size, rounded outlines, inconspicuous beak and marked overlap.

The dimensions of the two specimens are:

Length	.75 mm.	.78 mm.
Height L. V.	.48 mm.	.53 mm.
Width	.35 mm.	—

It is fairly abundant in the Upper Fort Scott limestone of locality 38. It is also present and often abundant in the same horizon at localities 2 and 13, in the Lower Fort Scott limestone at localities 7, 9, 12 and 28, in the upper two feet of the Labette shale at locality 43.

BAIRDIA CITRIFORMIS Knight, n. sp.

Plate 43, figs. 4 *a-c*

Outline, when seen from the side sub-triangular to sub-oval and from above sub-lanceolate, broadly sub-elliptical. The pointed and drawn out ends with the tendency to obesity suggest the outline of a lemon from either view. The dorsal line arched usually smoothly and more or less highly. Both the anterior and posterior dorsal line is either slightly convex or concave. The ventral line is gently curved to nearly flat medially, curving upwards more sharply toward the ends. The posterior beak is typically rather sharp and drawn out and is well down toward the ventral line. The anterior beak is also typically sharp and drawn out but is located obliquely well above the basal line. There is a tendency toward obesity exaggerated in some and repressed in other individuals. The overlap of the left valve is slight but continuous and even from beak to beak along the dorsal line. Ventrally the overlap is confined to a narrow median area. Owing to the inflation of the two valves the dorsal line and the ventral overlapped area are conspicuously impressed. These two latter characters taken in connection with the pointed beaks and the tendency to obesity are the most characteristic features of this rather variable species.

This species in its shorter, more rotund expression resembles *B. brevis* Jones and Kirkby rather closely but the more rotund outline with attenuated beaks when viewed from above will serve to distinguish it.

The dimensions of two individuals close to the extremes of variation are:

Length	.93 mm.	1.00 mm.
Height	.53 mm.	.47 mm.
Width	.45 mm.	—

Abundant in the lower two feet of the Pawnee limestone at locality 6.

BAIRDIA SUBCITRIFORMIS Knight, n. sp.

Plate 43, figs. 5 *a*, *b*

This species has much in common with *B. citriformis* but is probably distinct. It is quite possible that the differences are sexual or represent extreme individual variation but this is not likely. The larger specimens of *B. citriformis* are more obese than the younger specimens, whereas my three specimens of *B. subcitriformis* are all

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EXPLANATION OF PLATE 43

All figures ×30

FIGS. 1 *a–c.*—*Bairdia moorei* Knight, n. sp. *a*, right side; *b*, dorsal aspect; *c*, separate right valve.

2 *a–d.*—*Bairdia seminalis* Knight, n. sp. *a*, left valve; *b*, interior of same; *c*, right side of complete specimen; *d*, dorsal aspect of same specimen.

3 *a, b.*—*Bairdia auricula* Knight, n. sp. *a*, interior of left valve; *b*, exterior of same specimen.

4 *a–d.*—*Bairdia citriformis* Knight, n. sp. *a*, right side; *b*, left side; *c*, dorsal aspect, all of same specimen; *d*, right side of small specimen.

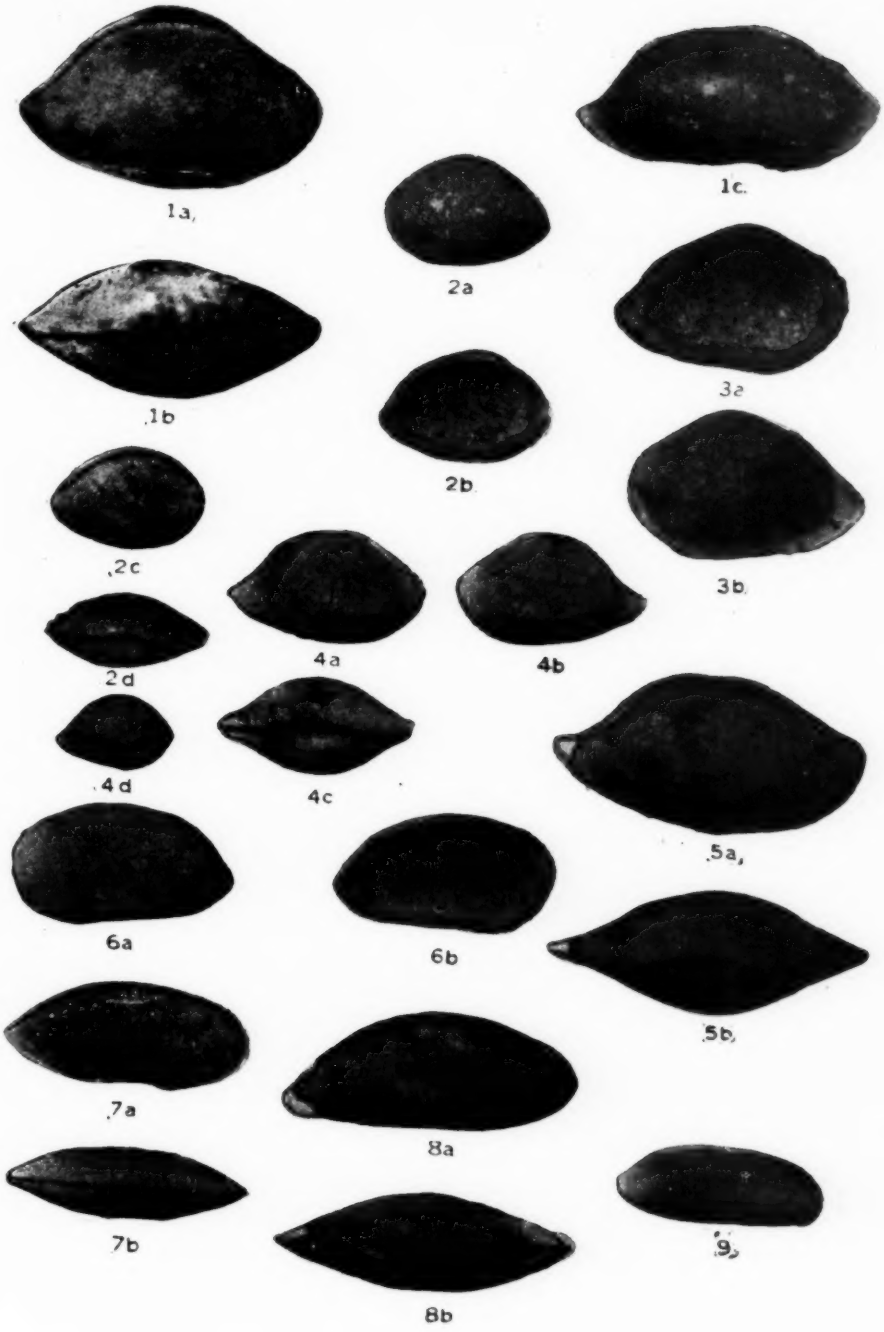
5 *a, b.*—*Bairdia subcitriformis* Knight, n. sp. *a*, right side; *b*, dorsal aspect of same specimen.

6 *a, b.*—*Bairdia altifrons* Knight, n. sp. *a*, exterior; *b*, interior of same left valve.

7 *a, b.*—*Bairdia haworthi* Knight, n. sp. *a*, right side; *b*, dorsal aspect of same specimen.

8 *a, b.*—*Bairdia glennensis* Harlton. *a*, right side; *b*, dorsal aspect of same specimen, beak restored.

9.—*Bairdia subelongata* (?) Jones and Kirkby, right valve, only specimen.


1a.
1c.
2a
1b
3a
2b
2c
3b
4a
4b
2d
4d
4c
5a.
6a
6b
5b.
7a
8a
7b
9.
8b

larger than the largest of the other and are not noticeably inflated. This species has in common with *B. citriformis* but to a less degree, the pointed ends as seen both from above and from the side, the impressed hinge-line and the even and slight overlap confined to the dorsal line and the median-ventral area. It differs from *B. citriformis* in its more angular outline and even more extended and almost upturned beaks. It is also not nearly so inflated.

The dimensions slightly restored are:

Length	1.53 mm.
Height	.75 mm.

Only moderately abundant in the lower two feet of the Pawnee limestone at locality 6.

BAIRDIA ALTIFRONS Knight, n. sp.

Plate 43, figs. 6 *a*, *b*

Outline of larger (left) valve sub-oblong. Dorsal outline gently bowed from the anterior to the posterior end of the hinge where it curves somewhat more strongly but roundly downward and is nearly straight before reaching the bluntly pointed and short posterior beak. Proceeding forward from this point the ventral line curves gently downward and forward for a short distance. The median two-thirds of the ventral line is nearly straight but with a broad reentrant curve medially. The anterior end is high and meets the antero-dorsal line in a sharp curve extending thence downward and obliquely backward. The overlap of the left valve is slight being greatest along the dorsum and least at the anterior end. The hinge-line is about 65% of the greatest length and gently arched. The smaller (right) valve is somewhat more elongate than the left but follows its outlines quite closely. The outline when viewed from above is elongate lanceolate, the thickest point being rather behind the middle.

This species resembles closely no Carboniferous form known to me. It has some similar outlines to *B. subelongata* var. *major* Jones and Kirkby but is much smaller and not nearly so elongated, nor so angular. It does not have the sharply upturned beak of *B. texana* of Harlton.

The dimensions of the figured specimen are:

Length	1.08 mm.
Height	.56 mm.

This form is rare in the Upper Fort Scott limestone at locality 38.

BAIRDIA HAWORTHI Knight, n. sp.

Plate 43, figs. 7 *a*, *b*

Outline as viewed from the side roughly sub-elliptical. Dorsal outline gently curved and low, the highest point posterior to the middle, and passing from that point to the ends in nearly straight lines. The beak of my one otherwise perfect specimen is broken but one may infer that it is bluntly pointed. The anterior end is narrowly but not acutely rounded. The ventral margin is gently convex near the ends and gently concave medianly. The right valve is shaped much like the left as the overlap is slight. As viewed from above the outline is narrow lanceolate, the sides being gently convex from end to end.

This form differs from *B. glennensis* in its lesser relative length, more nearly straight dorsal outline and less attenuated anterior end. From *B. altifrons* it is easily distinguished by its greater relative length and rounder lower anterior end.

The dimensions of the specimen figured after restoring the beak are:

Length	1.15 mm.
Height	.35 mm.

This form is rare in the Upper Fort Scott limestone at locality 38.

BAIRDIA GLENNENSIS Harlton

Plate 43, figs. 8 *a*, *b*

1927 HARLTON, Journ. Pal., vol. 1, no. 3, Dec., 1927, p. 210, pl. 33, fig. 10.

Outline in side view broadly and unequally sub-lanceolate. The dorsal outline forms an almost unbroken gentle curve from end to end with the highest point at about the middle. The posterior beak broken on my single otherwise nearly perfect specimen is inferred to be bluntly rounded. The ventral outline curving gently forward and downward from the beak is nearly straight for the greater part of its length. The anterior end is rather extended and sharply but not acutely rounded. As the overlap is slight the smaller (right) valve follows closely the curvature of the left. The greatest ventral overlap is expressed as a short rounded flap about halfway from each end. The outline as seen from above is narrow lanceolate with the gentle curvature continued to the ends. As seen from the ends the outline is sub-ovate with the greatest thickness below the mid-line.

This species is very distinct from any other in my collections. Its reference to *B. glennensis* depends somewhat on the accuracy of my

restoration of the missing posterior beak. If not identical it is closely related.

The dimensions of my only specimen as restored are:

Length	1.45 mm.
Height	.58 mm.

This species is rare in the Pawnee limestone at locality 6.

BAIRDIA SUBELONGATA (?) Jones and Kirkby

Plate 43, fig. 9

Bairdia subelongata JONES and KIRKBY, Journ. Geol. Soc. London, 1879, pp. 573-574, pl. 30, figs. 1-11, 16.

Bairdia subelongata HARLTON, Journ. Pal., vol. 1, no. 3, Dec., 1927, pp. 210-211, pl. 33, fig. 11.

This species is represented by a single right valve, slightly broken. Its outline is sub-elliptical. Dorsal line nearly straight, curving roundly at the posterior end of the hinge to meet the obtusely rounded beak with a short straight line. Anterior end rather narrowly rounded. Ventral margin slightly concave, medially and gently curved to meet the ends. Anterior end narrowly rounded.

This form is certainly distinct from *B. glennensis,* the dorsal curve being much flatter and the posterior end less drawn out. Its reference to *B. subelongata* must of course be doubtful based as it is on a single right valve.

Dimensions of the only specimen are:

Length	1.00 mm.
Breadth	.38 mm.

Found in the Upper Fort Scott limestone at locality 2.

Genus BYTHOCYPRIS Knight

This genus is represented in my collections by two rather typical and one doubtful species. While not rare they are far from being a conspicuous element in the Ostracode fauna and are perhaps of minor importance to the stratigrapher.

BYTHOCYPRIS PEDIFORMIS Knight, n. sp.

Plate 44, figs. 3 *a-c*

Outline suggesting roughly the imprint of a broad moccasined human foot, the anterior margin forming the heel and the post-ventral beak the great toe. Posterior and dorsal margin form an

unbroken curve from the posterior beak which is in line with the ventral margin to just anterior to the centrally located highest point where the curve flattens very slightly and then curves roundly out to a short radius around the end. The curve of the anterior end meets that of the ventral margin smoothly and that of the ventral margin itself is straight to very slightly concave for its anterior three-fifths, then proceeding posteriorly shows a slight convexity a little behind the middle after which it proceeds nearly straight to the beak. The beak is almost blunt-pointed and gives the appearance of pointing downward. The left valve is the larger extending beyond and overlapping the right a small amount all around, more ventrally than elsewhere. The surface is smooth. The dorsal aspect is narrow ovate, heavier posteriorly and rather fine anteriorly.

This species resembles *B. parallela* Knight rather closely but is more arched dorsally. It is less arched than *B. pyrula* Jones and Kirkby and differs in outline from forms described by these authors as *B. cuneola* under which designation are possibly figured as many as three Bythocyprids and what appears to be a *Healdia* or two. It does not closely resemble any described American Carboniferous species known to me. If I were called upon to differentiate this form from *B. silicula* described from the Cretaceous by Jones and Hinde[1] I could say only that my form is more bluntly rounded posteriorly when seen from above.

Dimensions of two individuals are:

Length	.65 mm.	.61 mm.
Height	.36 mm.	.36 mm.
Width	—	.22 mm.

Not very abundant in the Upper Fort Scott limestone at locality 13 and 38.

BYTHOCYPRIS PARALLELA Knight, n. sp.

Plate 44, figs. 2 *a*, *b*

Posterior margin commencing at the beak well arched and curving roundly into the slightly arched to nearly straight dorsal margin on which the highest point is in front of the middle. Anterior end rounds in almost a semi-circle smoothly, from the dorsal to ventral margin which is straight to slightly concave in the middle. Beak a little less pointed and prominent than in *B. pediformis*. Dorsal view is narrow ovate and a little thinner and with sides more nearly par-

[1] A supplementary monograph of the Cretaceous Entomostraca of England and Ireland, Paleontographical Society, vol. XLIII, p. 13.

allel than in *B. pediformis*. The surface is smooth, the left valve larger than the right and overlapping it slightly.

This species may be erroneously established on individual variants of *B.pediformis* but this does not appear to me to be probable. It is represented in my collections by several specimens all having in common as distinct from that form the flatter and nearly parallel dorsal and ventral margins as well as sides. The beak is less prominent and the anterior end is proportionately higher. It also exhibits greater relative length as compared with height. It has some resemblance to one of the forms described by Jones and Kirkby as *B. cuneola* but has a squarer anterior outline.

Dimensions of two specimens:

Length	.66 mm.	.62 mm.
Height	.34 mm.	.30 mm.

Not at all abundant in the Upper Fort Scott limestone at locality 2 and 38.

BYTHOCYPRIS (?) ROSTRATA Knight, n. sp.

Plate 44, figs. 1 *a-c*

Outline in side view sub-cuneiform, the posterior end being much lower than the anterior. The dorsal profile is only slightly arched but obliquely tilted backward throughout the greater part of its length. The postero-dorsal line meets the dorsal roundly and proceeds obliquely backward and downward to meet the ventral line at a rather sharp point. The anterior profile is of course higher and more roundly curved obliquely forward meeting the ventral line at a sharp anterior beak which gives a down-turned effect without actually being extended downward. The ventral line is nearly straight but curves upward slightly as the pointed ends are approached with the longest up curve anteriorly. The dorsal view is sub-elliptical with flatly curved sides carrying the fullness well out toward the ends, then curving to the ends forming a rather wide angle. Both ends are pointed but the anterior beak extends outward the more as a sharp keel when seen from above. The end view is subcylindrical with roundly curved sides and back but with a conspicuously flat bottom particularly near the posterior end. The valves are nearly equal with the left slightly the larger. The surface is smooth and unornamented unless the keel-like beak can be considered ornamentation.

The sharply angled beak at the anterior-ventral corner of this

species is quite unique within the genus *Bythocypris* but as the species conforms in all other respects I am provisionally referring it to that genus. This species is clearly differentiated from other Bythocyprids known to me by its more pointed ends and flat venter. It resembles *Cypris* (?) *purbeckensis* Forbes somewhat but has more inflated sides and sharper ends.

The dimensions of a typical specimen are:

Length	.68 mm.
Height	.30 mm.
Width	.32 mm.

Not at all common in the lower two feet of the Pawnee limestone at locality 6.

Genus HEALDIA Roundy

This genus, doubtfully referable to the family Bairdiidae, is represented in my collections by four species, two of moderate size and two very small forms, all typical of the genus but only one carrying well developed posterior spines. This somewhat recently established and interesting genus gives promise of some value in stratigraphic work. Its members appear to be abundant and easily differentiated.

HEALDIA NUCLEOLATA Knight, n. sp.

Plate 44, figs. 4 *a-c*

Comparatively very small. Outline in side view sub oval; the post dorsal slope flattened. The end margins are smoothly rounded; dorsal line arcuate with the highest point at about the middle, ventral margin gently arched to flat. Dorsal aspect wedge shaped, thickest near the posterior end on which the sides converge at an angle of about 100°. The sides arch gently to the acute angled anterior end. Valves quite convex. About one eighth the total length in front of the posterior margin of each valve is a curved ridge with its convexity posterior, reaching not quite to the dorsal margin. This ridge is rather narrow and indistinct but has some relief on the forward side as well as the greater on the posterior. Occasionally the generic tendency to develop a pair of spines near the ends of this ridge is expressed in extremely indistinct posterior bulgings as though the beginnings of spines were present. The valves are unequal the left being larger than the right and overlapping it slightly all around except along the post-dorsal slope. Surface smooth with rarely a very

slight depression at the centrally located point of attachment of the muscle.

This small *Healdia* is smaller than any other described form known to me except *H. ciscoensis* Harlton and *H. boggyensis* Harlton; from the former of which it differs in being much less arched dorsally and having a greater ratio of length to height. From the latter it differs in having a less pointed anterior end. From both it apparently differs in having even less developed spines. In several ways my form appears to be intermediate between Harlton's two species mentioned above. *H. leguminoides* is proportionately longer and has a concave venter.

The average dimensions of four species are:

Length	.442 mm.
Height	.282 mm.

Very abundant in the Upper Fort Scott limestone at locality 38. Found also in the same horizon at locality 2.

EXPLANATION OF PLATE 44

All figures ×30

FIGS. 1 *a–c.—Bythocypris* (?) *rostrata* Knight, n. sp. *a*, right side; *b*, ventral aspect; *c*, dorsal aspect.

2 *a, b.—Bythocypris parallela* Knight, n. sp. *a* and *b*, right sides of two specimens.

3 *a–c.—Bythocypris pediformis* Knight, n. sp. *a*, left side; *b*, dorsal aspect; *c*, right side of latter specimen.

4 *a–c.—Healdia nucleolata* Knight, n. sp. *a*, dorsal aspect; *b*, right side of same specimen; *c*, right side of another specimen.

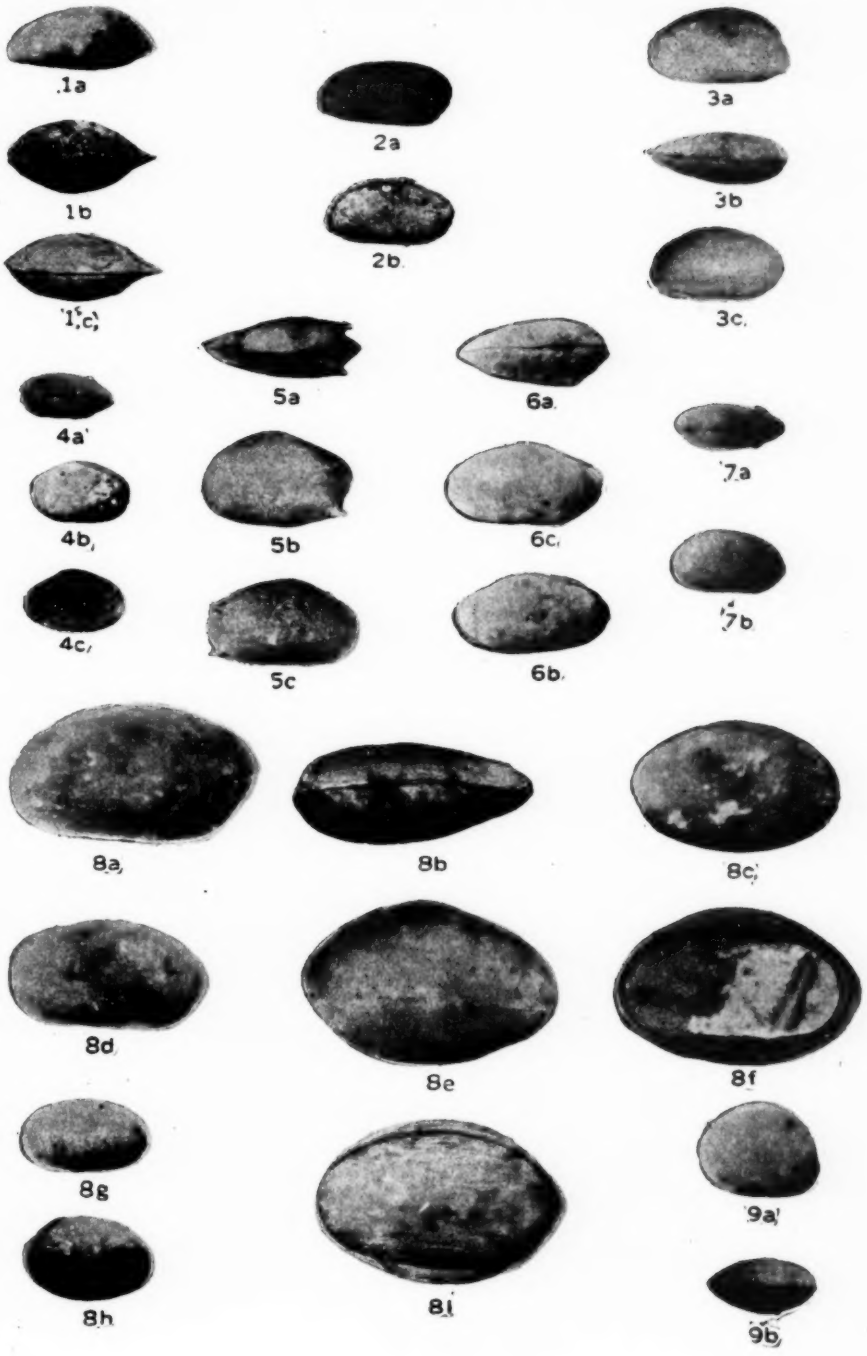
5 *a–c.—Healdia limacoidea* Knight, n. sp. *a*, dorsal aspect; *b*, left valve; *c*, right valve.

6 *a–c.—Healdia longa* Knight, n. sp. *a*, dorsal aspect; *b*, left valve; *c*, right side, all of same specimen.

7 *a, b.—Healdia leguminoidea* Knight, n. sp. *a*, dorsal aspect; *b*, right side of same specimen.

8 *a–i.—Cytherella missouriensis* Knight, n. sp. *a*, left valve of large individual; *b*, dorsal aspect; *c*, right valve of moderate sized individual; *d*, right valve of about same size; *e*, right side of same specimen as *b*; *f*, interior of large right valve; *g*, left valve of small specimen; *h*, right valve of small specimen; *i*, left side of same specimen as *b* and *e*.

9 *a, b.—Carbonia* (?) *lenticularis* Knight, n. sp. *a*, right side; *b*, dorsal aspect.


1a
1b
1c
2a
2b
3a
3b
3c
4a
4b
4c
5a
5b
5c
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6b
6c
7a
7b
8a
8b
8c
8d
8e
8f
8g
8h
8i
9a
9b

HEALDIA LEGUMINOIDEA Knight, n. sp.

Plate 44, figs. 7 *a, b*

Outline sub-reniform or bean shaped. The dorsal margin is gently arched, the highest point being posterior to middle; the post-dorsal slope short and straight. The ends are rounded and rather low. The ventral margin is slightly concave. Dorsally the outlines are wedge shaped, blunt posteriorly and tapering anteriorly. Quite close to the posterior end the surface of the valve rises rapidly forming a curved and rounded obscure escarpment bluntly angular near the post-dorsal and ventral margins. The surface is smooth bearing no other ornamentation except that a slight dimpling of the carapace is noted at the point of attachment of the central muscle.

This species is differentiated from *H. nucleolatus, H. ciscoensis* Harlton and *H. boggyensis* Harlton, by its less arched dorsum, its concave ventral line and its longer slimmer appearance; the posterior curved ridge is also somewhat less distinct. From all others known to me it differs by its small size.

Its dimensions are:

Length	.52 mm.
Height	.29 mm.
Width	.21 mm.

Only one very perfect specimen was found in the Upper Fort Scott limestone at locality 38, and another in the same horizon at locality 2.

HEALDIA LONGA Knight, n. sp.

Plate 44, figs. 6 *a-c*

Form in side view elongate, sub-elliptical, appearing as though the posterior dorsal edge of the ellipse were chopped off. Anterior end narrowly rounded curving evenly into the rather flat ventral margin. About two-thirds the way back the ventral margin begins to curve upwards at first gradually and then more abruptly to the rounded beak which is situated about three-fifths the way above the ventral margin. The posterior outline curves sharply around the beak and then in a nearly straight or slightly curved convex line to the top of the rounded dorsal hump, thence with a slight convexity till it meets and blends with the anterior margin. The dorsal aspect is lanceolate-ovate with the thickest part about one-fifth the length in front of the posterior end, the sides curving in rapidly from this point with a slight concavity before reaching the end. The concentric ridge so common in this genus bordering the posterior thickened

area is present but is very inconspicuous. The surface is smooth without spines or ornamentation of any kind. The left valve is larger than and slightly overlaps the right except along the post-dorsal slope.

This species is longer and thinner in outline than any other of my acquaintance except perhaps *H. ampla* Roundy, from which it may be differentiated by its lack of posterior spines and considerably smaller size.

Dimensions of two specimens are:

Length	.71 mm.	.71 mm.
Height	.37 mm.	.34 mm.
Width	.30 mm.	—

This species is rather rare in the Upper Fort Scott limestone at locality 38.

HEALDIA LIMACOIDEA Knight, n. sp.

Plate 44, figs. 5 *a-c*

The appearance of a single valve is strongly suggestive of a slug with rounded instead of pointed posterior. Anterior end roundly curved, the dorsal margin convex, a little more flatly so posteriorly than anteriorly; the highest and sharpest point of the curve being a little back of the middle. The posterior end is more sharply rounded than the anterior, most sharply so near its juncture with the dorsal margin. The ventral margin is straight or slightly bowed, either in or out. It joins the curvature of the ends in a more or less even curve. The ratio of height to length is somewhat variable, some individuals being over twice as long as high and others hardly more than one and one half times, with all degrees of variation in between. The specimens figured are of the most characteristic proportions. The dorsal aspect is narrowly wedge shaped, the outlines posteriorly meeting at an angle of about 75°. The widest point is about one fifth the length in front of the posterior end tapering forward to an acute angle at the anterior end. Except for the ends this outline is not angular but smoothly curved. Near the posterior end the contours of the widest section fall away to that end over an indistinct crescentic ridge from near each end of which protrudes a spine directly backwards, both diverging somewhat from the median line and slightly curved. The length of the spines varies from a mere tubercle to somewhat longer than in the specimens figured. The surface of the valves is otherwise smooth and unornamented except that in some specimens the centrally located muscle spot is discern-

able as a slight depression with indistinct radiating canals extending a short distance out. The left valve is the larger overlapping the right slightly except on the post-dorsal slope.

This species is differentiated from *H. ampla* Roundy in its smaller size and rounder outline, from *H. oklahomensis* Harlton and *H. overbrookensis* Harlton by the presence of two spines on each valve, symmetrically arranged on each.

The dimensions of these individuals are:

Length	.70 mm.	.70 mm.	.74 mm.
Height	.45 mm.	.40 mm.	—
Breadth	—	—	.27 mm.

This species is rather abundant in the Upper Fort Scott limestone at localities 13 and 38.

Family CYTHERELLIDAE Sars

Genus CYTHERELLA Jones

Cytherellids are abundant in numbers in my collections though not in species. The individuals referred to *C. missouriensis* may represent several species but if so I am at a loss to know how to discriminate between them except by size—and this may simply reflect the age of the individual.

CYTHERELLA MISSOURIENSIS Knight, n. sp.

Plate 44, figs. 8 *a-i*

The outline of right (larger) valve as seen from the side is subelliptical to sub-oval. The dorsal outline is generally but not always more prominently convex than the ventral. The anterior margin is semi-circularly rounded, the posterior end is usually slightly more sharply rounded than the anterior and usually with the most posterior point slightly and obliquely above the center line. The left (smaller) valve is gently arched dorsally, rounded posteriorly, slightly concave ventrally and more narrowly and obliquely rounded posteriorly with the most posterior point obliquely above the center line. The last feature is generally more distinct on the left than on the right valve. The dorsal view gives a rounded subcuneiform outline with the posterior end the thickest and obtusely rounded and the anterior straighter sided and more acute.

The right valve is considerably larger than the left with thickened dorsal and ventral margins reflexing on the left side. The margin of

the right valve is rabbetted all around to take the edges of the left valve which fit into it and in some specimens a narrow irregular and very thin flange extending slightly over the edges of the right, especially dorsally. The surface is smooth and unornamented.

This species resembles rather closely *C. subreniformis* Jones and Kirkby in some respects particularly in the rather deeply reflexed ventral and dorsal margins of the right and concave ventral margin of the left valve. However Jones and Kirkby's species has a lanceolate outline when seen from above whereas my species is distinctly cuneiform. It differs from *C. benniei,* var. *intermedia* Jones and Kirkby in the wider reflexed margins of my species and in the more obtusely rounded posterior end.

I have quite a number of specimens in my collection all of which conform to the above description but which are quite variable in size and which appear to be mature and young specimens of the same species. Several representative dimensions are:

Length	R. V.	1.15	1.14	.97	.—	.61	.—
	L. V.	.—	.—	.—	.92	.57	.57
Height	R. V.	.77	.72	.62	.—	.39	.—
	L. V.	.62	.57	.—	.48	.34	.32
Width		.46	.—	.—	.—	.—	.—

Abundant in the Upper Fort Scott limestone at locality 38.

Super-family CYTHERACEA

Family CYTHERIDAE Zenker

Genus CARBONIA Jones

This supposedly fresh or brackish water genus appears to be represented in my collections, all from typically marine beds, by one species. Its reference to the genus on that account alone may be questioned. Nevertheless while rather a characterless little shell, as far as generic features are concerned it agrees more closely with *Carbonia* than other genera.

CARBONIA (?) LENTICULARIS Knight, n. sp.

Plate 44, figs. 9 *a, b*

Small, dorsum highly arched, ventral line gently convex to nearly straight. Anterior end broadly rounded, meeting the ventral line

smoothly but with a slight backward obliquity. Posterior end falls downward from the dorsal line with a flat curve almost to the ventral line where it rounds sharply but smoothly into the venter. Outline when viewed from above sub-ovate. End view acutely sub-ovate with the greatest width above the middle and with the lines of the sides converging ventrally rather flatly. Valves almost equal with the right possibly very slightly the larger but not overlapping. Surface smooth and without ornamentation. A very obscure sub-central stellate muscle spot can be made out in some specimens.

This species agreeing morphologically with *Carbonia* supposedly a brackish water form, is referred tentatively to that genus as its associations are entirely marine. It resembles somewhat *Carbonia fabulina* Jones and Kirkby and the variety *sub-angulata* of the same authors, but is more rounded in side view. Its side view is quite similar to that of *Bythocypris* (?) *thraso* Jones and Kirkby but it is thinner in edge view.

The dimensions are:

Length	.57 mm.	.51 mm.
Height	.43 mm.	—
Width	—	.27 mm.

Fairly abundant in the lower two feet of the Pawnee limestone at locality 6.

REGISTER OF LOCALITIES FROM WHICH OSTRACODES WERE COLLECTED

Locality No. 2.—Shaley upper surface of the Upper Fort Scott limestone exposed in vacant lot at northwest corner of Gustine and MacDonald Streets, St. Louis.

6.—Decomposed blocks and residual from lower two feet of Pawnee limestone exposed in street making in Davis Place subdivision, Clayton, St. Louis County. First (unnamed) street west of Kirkwood-Ferguson trolley tracks and 200 feet north of Clayton Road.

7.—Shale partings in the Lower Fort Scott limestone in cut of the C. R. I. & P. R. R. in Clayton, St. Louis County. Under traffic bridge 200 yards east of station.

9.—Shale partings in the Lower Fort Scott limestone on the north wall of the Hydraulic Pressed Brick Company shale pit east of the Ballas Road and between the Conway and Olive Street Roads, St. Louis County.

11.—Shale partings in the Lower Fort Scott limestone exposed in the shale pit of the Alton Brick Company about 1 mile southeast of Costello, St. Louis County.

12.—Shale partings in the Lower Fort Scott limestone exposed in the Charbonnier Bluff on the Missouri River. Survey No. 276.

13.—Shaley upper surface of the Upper Fort Scott limestone exposed in Belt Line (T. R. R. A.) cut south of Clayton Road and west of Hanley Road, St. Louis County.

28.—Shale partings in the limestone exposed in subdivision grading just east of Tamm Avenue and north of Manchester Avenue, Cheltenham district, St. Louis. Probably, but not certainly, Upper Fort Scott.

37.—Shale partings in Upper Fort Scott limestone exposed in T. R. R. A. cut 500 yards north of Manchester Avenue and 200 yards west of Macklind Avenue, Cheltenham district, St. Louis.

38.—Shale partings in Upper Fort Scott limestone exposed in south bank of creek east of Price Road and south of Ladue Road, St. Louis County.

43.—From the upper two feet of Labette shale exposed along creek in hollow just north of right angle west turn of Scheute Road, ½ mile southwest of Lackland station on the C. R. I. & P. and ¾ mile north of Stratman, St. Louis County.

SOME PENNSYLVANIAN FORAMINIFERA OF OKLAHOMA, WITH SPECIAL REFERENCE TO THE GENUS OROBIAS

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INTRODUCTION

ABSTRACT

The walls of nearly all Paleozoic Foraminifera, instead of being constructed of agglutinated foreign particles, as has been held for many years, are calcareous and were secreted by the animal. The walls of *Ammovertella*, *Endothyra*, *Tetrataxis* and the Fusulinidae are calcareous and not agglutinated or arenaceous. Arenaceous forms were derived from calcareous forms, instead of the reverse.

Nine new species of Pennsylvanian Foraminifera are described, and one new genus, *Tuberitina*. The earlier generic name *Orobias* is restored in place of the later synonyms, *Nummulostegina*, *Palaeonummulites* and *Ozawaina*. Nineteen species of *Orobias* are listed or described, three of which are new.

Paleozoic Foraminifera are less well preserved than more recent ones, and on that account there is much confusion as to the wall material and texture of Paleozoic Foraminifera, and consequently confusion in identification. The walls have frequently been calcified and rendered granular, silicified and made insoluble in acid, and sometimes made hyaline, or corroded so that the original appearance is lost. The walls are therefore usually described as "arenaceous", "very finely arenaceous, of calcareous material with much calcareous cement", or "subarenaceous", whereas in most Paleozoic genera of Foraminifera the walls were secreted by the animal and were calcareous and imperforate. On account of the importance of the wall material and texture in defining families and genera, the lack of

correct understanding of the walls has caused different authors to include the same species in several different genera. For instance, Carboniferous spirilline forms have been identified as *Spirillina, Cornuspira,* or *Ammodiscus,* depending more upon the viewpoint of the author than upon the original character of the walls, and *Endothyra* has been referred to as arenaceous, but it is calcareous and imperforate.

Some authors (Schmidt, Spandel and others) do not mention the wall material. A large number of Paleozoic species have been so imperfectly described and figured that they cannot be recognized, even generically. More exact knowledge of the wall material, texture and structure of Paleozoic Foraminifera is urgently needed.

The idea has been almost universally held that arenaceous forms of Foraminifera are the most primitive, and that as a consequence Paleozoic Foraminifera must be arenaceous. That idea is in error, for there are no arenaceous Foraminifera known prior to the Devonian, whereas calcareous forms with secreted walls do occur in the Cambrian, Ordovician and Silurian. In the upper Paleozoic, arenaceous forms are rare in occurrence as compared with calcareous forms, contrary to the prevailing idea. On account of the earlier occurrence of calcareous forms, as well as the evidence in other directions, it is far more probable that arenaceous forms have been derived from calcareous forms. Paleozoic forms should be assumed to be calcareous unless they can be proved arenaceous, rather than the reverse. The idea of Waters that a genus may be either calcareous or agglutinated depending on the sediment on which it lived (Journ. Pal., vol 1, no. 4, p. 271) needs much more proof to be convincing.

In the present study particular attention has been paid to wall material and texture. Thin sections have been prepared of most of the species. The insides of the tests are filled with calcite, and the walls are usually composed of exceedingly fine calcite crystals which resulted from the crystallization of the original calcareous walls, showing no pores or alveolar structure. In the Fusulinidae the walls have a thin, dark, outer layer and a thicker, light-colored inner layer, which may or may not be alveolar. Many specimens have been silicified in part or entirely.

In the Mid-Continent oil fields, the genera *Endothyra, Orobias* and *Staffella* first become common in the Lower Pennsylvanian. The genus *Orobias* is the most diagnostic form. Although the species of *Orobias* can be distinguished by means of thin sections, it is very difficult and not so satisfactory as identification from external ap-

pearance. Many different species occur, and the ease with which species can be identified from the exterior adds to their importance in economic work.

The species described are from Pennsylvanian formations of Oklahoma.

On account of the confusion which exists as to the names and definitions of the various genera, the complete synonomy and definitions are given.

SYSTEMATIC PART

Family MILIOLIDAE d'Orbigny, 1846

Genus CORNUSPIRA Schultze, 1854

Genotype (first species, designated by Cushman, 1928) *Cornuspira planorbis* SCHULTZE, Organis. Polythal., 1854, p. 40, pl. 2, fig. 21. (Recent, coast of Mozambique.)—BRADY, Rep. Voy. *Challenger*, Zool., vol. 9, 1884, p. 198.—CHAPMAN, Foraminifera, 1902, p. 99.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, 1917, p. 24; Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 4, 1927, p. 188; Spec. Publ. no. 1, 1928, p. 160. (*Orbis foliaceus* PHILIPPI, 1844, which BRADY, 1884, and CUSHMAN, 1917, wrongly selected as the type, is not the same species as *C. planorbis*.)

Cyclogyra WOOD, Ann. Mag. Nat. Hist., vol. 9, 1842, p. 458, pl. 5, fig. 5, not definitely recognizable.

Test free, planispiral, composed of a proloculum followed by a long, round or flattened tube, enlarging gradually, sometimes with a few septa; wall porcellaneous, imperforate, smooth except for growth lines; aperture the open end of the tube, lunate or elongate, sometimes constricted with thickened lip. Diameter, up to 31 mm. Strand down to 1900 fathoms. Carboniferous to Recent.

CORNUSPIRA HARLTONI (Cushman and Waters)

Plate 45, figs. 1 *a-c*

Hemigordius harltoni CUSHMAN and WATERS, Contrib. Cushman Lab. Foram. Res., vol. 4, pt. 2, 1928, p. 43, pl. 5, figs. 8, 9.

Test nearly equally biconvex, consisting of a globular proloculum and a long undivided tube coiled regularly in one plane, gradually increasing in size, and making five or six whorls; the last two or three whorls only are visible on the exterior, the central portion of the spire being coated with calcium carbonate which thickens toward

the center; wall calcareous, readily soluble in acid, partly porcellaneous and partly hyaline, imperforate; aperture formed by the open end of the tube. Diameter, 0.8 mm.

Holotype.—Columbia University, Pal. Coll. No. 19931.

Upper Glenn, (surface outcrop) SW¼ of NW¼ of NE¼ of sec. 16, T. 6 S., R. 2 E., Love County, Oklahoma, about 8.5 miles south of Ardmore.

This form is easily recognized on account of the secondary material concealing the early part of the spire. Under high powers of the microscope the walls are minutely granular, which appearance might be mistaken for agglutinated grains.

Family SPIRILLINIDAE Rhumbler, 1895

Genus AMMOVERTELLA Cushman, 1928

Genoholotype *Ammovertella inversa* (SCHELLWIEN) = *Psammophis inversus* SCHELLWIEN, Paleontographica, vol. 44, 1898, p. 266, pl. 23, fig. 10. (Upper Pennsylvanian, Auernigian, Carnic Alps.) *Psammophis* SCHELLWIEN is a homonym of *Psammophis* BOIE, 1827, a genus of snakes.

Ammovertella CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 4, pt. 1, 1928, p. 8.

Test free (?) or attached, tubular, the early portion planispiral, the latter portion folded back and forth; wall siliceous and finely arenaceous according to Schellwien, calcareous and imperforate in specimens from Oklahoma; aperture the open end of the tube. Length, up to 0.5 mm. Shales. Pennsylvanian of the Carnic Alps and Oklahoma; Jurassic (Haeusler).

AMMOVERTELLA UNDULATA, n. sp.

Plate 45, fig. 2

Test minute, firmly attached to other fossils, consisting of a coiled portion of about one whorl which is followed by 4 to 7 regular undulations, the tube and the undulations gradually increasing in size; the tube is flattened on the attached side; wall calcareous, readily soluble in acid, imperforate, not arenaceous, but minutely granular, of a yellow color; aperture semicircular, the open end of the tube. Length, 0.25 mm.; diameter of tube, 0.025 to 0.035 mm.

Holotype.—Columbia University Pal. Coll. No. 19938.

Atoka formation, (surface outcrop), along creek, N½ of sec. 11, T. 5 N., R. 21 E., Latimer County, Oklahoma, about two miles south of Red Oak.

The Oklahoma specimens agree very well with the figure of Schellwien's *Psammophis inversus* in size and regularity of the undulating portion of the test, but have a smaller spiral portion and the tube does not increase so rapidly in size. Schellwien does not say whether or not his specimen was attached, but judging from its size and shape and from our specimens, it must have been. Regarding the wall he says, "Das Material der Schaale ist ein kieseliges, aus feinem Trümmermaterial gebildet, dessen Theile sich im polarisirten Licht scharf von einander abheben." His specimen must have been silicified or the walls had been crystallized.

AMMOVERTELLA LATIMERENSIS, n. sp.

Plate 45, figs. 3, 4

Test adherent, with rounded proloculum and a planispiral coil of about two whorls, which are followed by a long irregularly coiling tube sometimes coiling upon itself, as shown in fig. 3; irregular growth lines are visible on the tube; wall calcareous, subporcella-

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EXPLANATION OF PLATE 45

FIGS. 1 *a–c.*—*Cornuspira harltoni* (Cushman and Waters). ×35. *a*, side view; *b*, apertural view; *c*, section.

2.—*Ammovertella undulata*, n. sp. ×100.

3, 4.—*Ammovertella latimerensis*, n. sp. ×70. 3, holotype; 4, *a* specimen coiled upon itself.

5.—*Ammovertella ? confusa*, n. sp. ×35.

6.—*Bullopora wapanuckaensis*, n. sp. ×50.

7 *a–c.*—*Bullopora redoakensis*, n. sp. ×30. *a*, holotype; *b*, *c*, paratypes.

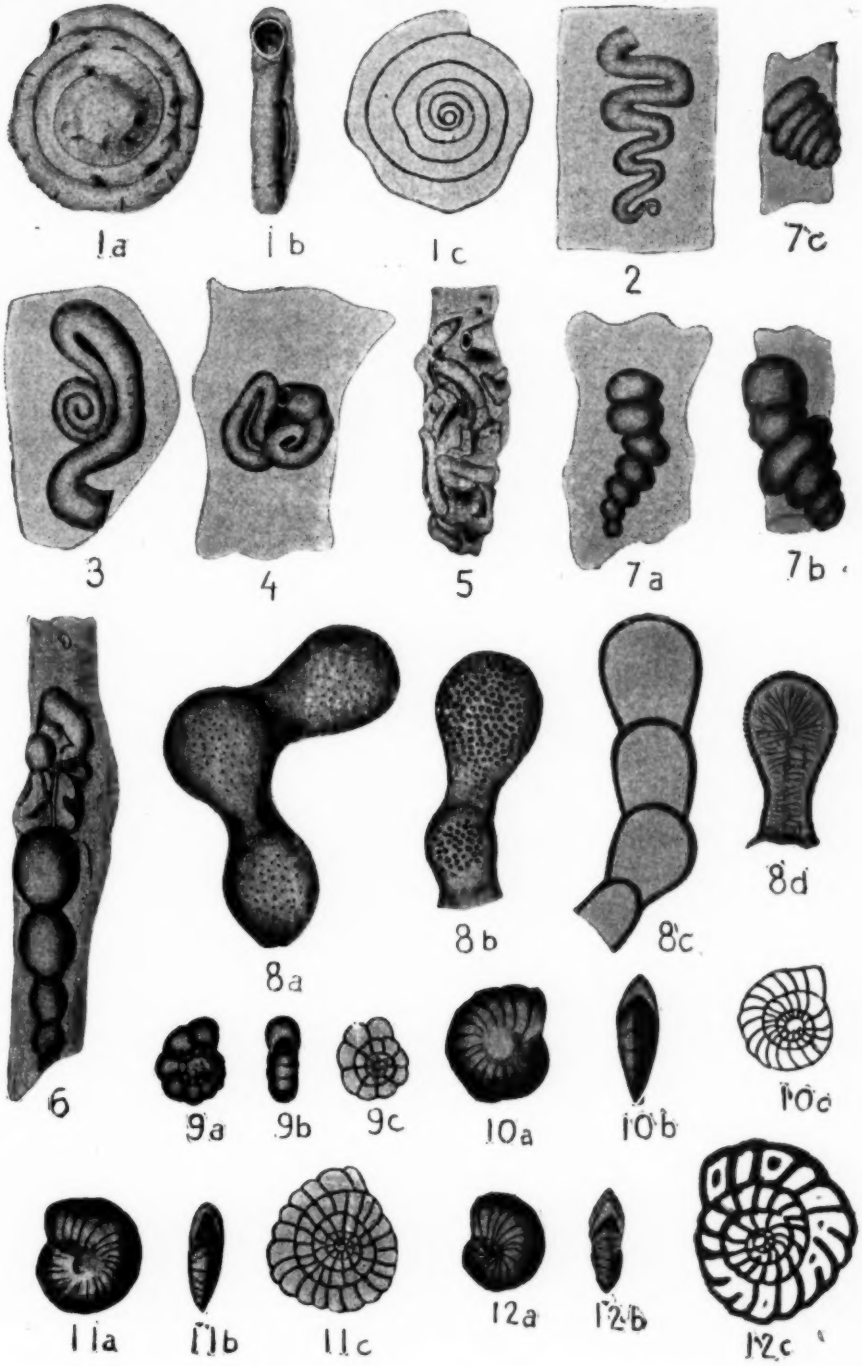
8 *a–d.*—*Tuberitina bulbacea*, n. sp. ×35. *a*, holotype; *b*, specimen showing punctate surface; *c*, thin section; *d*, thin section, showing wall structure.

9 *a–c.*—*Endothyra ameradaensis* Harlton. ×35. *a*, side view; *b*, apertural view; *c*, median section.

10 *a–c.*—*Orobias biumbonata*, n. sp. ×55. *a*, side view; *b*, apertural view; *c*, median section.

11 *a–c.*—*Orobias ciscoensis* (Harlton). ×35. *a*, side view; *b*, apertural view; *c*, median section.

12 *a–c.*—*Orobias radiata* (Brady). ×35. *a*, side view; *b*, apertural view; *c*, median section.


1a
1b
1c
2
7c
3
4
5
7a
7b
6
8a
8b
8c
8d
9a
9b
9c
10a
10b
10c
11a
11b
11c
12a
12b
12c

neous, readily soluble in acid; aperture single, simple, terminal. Length, 0.44 mm; diameter of tube, 0.03 to 0.08 mm.

Holotype.—Columbia University Pal. Coll. No. 19932; paratype, 19933.

Atoka formation, (surface outcrop), along creek, N½ of sec. 11, T. 5 N., R. 21 E., Latimer County, Oklahoma, about two miles south of Red Oak.

This species differs from *A. inversa* (Schellwien) in the less regularity of coiling in the later part. It differs from *A. inclusa* (Cushman and Waters) (Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 3, 1927, p. 148, pl. 26, fig. 12) in the smaller size and calcareous walls.

AMMOVERTELLA ? CONFUSA, n. sp.

Plate 45, fig. 5

Test attached to crinoid stems or bryozoa, consisting of a long very irregularly winding, tubular chamber in a confused mass; wall consisting of dolomite and calcite crystals, apparently finely arenaceous, with calcareous cement; aperture single; at the end of the tube. Diameter of tube, 0.07 mm.

Holotype.—Columbia University Pal. Coll. No. 19934.

Upper Glenn, (surface outcrop) SW¼ of SE¼ of SE¼ of sec 12, T. 6 S., R. 1 E., Love County, Oklahoma, about seven miles south of Ardmore.

The very irregular arrangement of the coil is a feature easily recognized. This species may belong to *Tolypammina*.

Family NODOSINELLIDAE Rhumbler, 1895

Genus BULLOPORA Quenstedt, 1856

Genotype (first species named, here designated) *Bullopora rostrata* QUENSTEDT, Der Jura, fasc. 2, 1856, p. 292, pl. 41, fig. 26 (species not named); fasc. 3, 1856, p. 554, pl. 72, fig. 35 (species not named); p. 580, pl. 73, fig. 28. (Upper Jurassic, Reichenbach, Germany.)

Webbina (part) D'ORBIGNY, Prod. Pal., vol. 2, 1850, p. 111.—TERQUEM, Mém. Acad. Imp. Metz, vol. 42, 1862, p. 456, pl. 6, figs. 15-19; vol. 51, 1870, p. 373, pl. 29, figs. 19-30; Mém. Soc. Géol. France, ser. 3, vol. 4, 1886, p. 16, pl. 7, figs. 43-48.—SOLLAS, Geol. Mag., dec. 2, vol. 4, 1877, p. 102, pl. 6.

Vitriwebbina CHAPMAN (genotype, first species, designated by CUSHMAN, 1927, *V. sollasi* CHAPMAN), Geol. Mag., n. s., dec. 3, vol. 9, 1892, p. 52, pl. 2, figs. 1-4.—BAGG, U. S. Geol. Surv. Bull. 88, 1898, p. 35, misspelled "*Vitre-*

webbina".—CUSHMAN, Contrib. Cushman, Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 49; pt. 3, 1927, p. 189.

Placopsum RHUMBLER, Foram. Plankton-Exped., pt. 2, 1913, p. 445, figs. 148-153.

Placopsilina (part) of authors.

Test generally attached by the whole of one side, sometimes free or in life attached to plants, consisting of several bulbous chambers which just touch or are separated by tubular necks, gradually enlarging, and arranged in a curvilinear manner, the initial end sometimes planispirally coiled; surface smooth, pitted or tuberculate; wall calcareous, hyaline or opaque, imperforate or finely perforate; aperture terminal, single, simple, round or compressed on one side, generally at the end of a long neck. Length, up to 1.5 mm. or more. Shallow water deposits, attached to plants, shells and other objects. Pennsylvanian of Oklahoma; Jurassic and Cretaceous of Europe, and Eocene of New Jersey.

Bullopora appears to be a degenerate derivative from *Nodosinella* or other genera of the Nodosinellidae, and not from *Polymorphina*. There appears to be no generic distinction between *Bullopora* and *Vitriwebbina*.

BULLOPORA WAPANUCKAENSIS, n. sp.

Plate 45, fig. 6

Test attached, small, straight, elongate, tapering; chambers few, usually 5 or 6, inflated; sutures deep; wall calcareous, imperforate; aperture single, terminal. Length, 1 mm.

Holotype.—Columbia University Pal. Coll. No. 19936.

Wapanucka limestone, (surface outcrop), shale near base of Wapanucka limestone, quarry two miles south of Hartshorne, NW¼, sec. 18, T. 4 N., R. 17 E., Pittsburg County, Oklahoma.

The straight, tapering shape and the inflated chambers distinguish this species. It is a diagnostic form of the Wapanucka limestone but has also been found in the Caney shale. It is very similar to *Nodosaria ovalis* Schmidt (Neues Jahrb., 1867, p. 585, pl. 6, fig. 50) but differs in being attached.

BULLOPORA REDOAKENSIS, n. sp.

Plate 45, figs. 7 *a-c*

Test attached, small, straight or curved, elongate, tapering; chambers uniserial, numerous, strongly inflated, irregular in size, compressed but not embracing part of the previous chamber; sutures

deep; wall calcareous, imperforate, granular; aperture single, terminal. Length, 0.8 mm.

Holotype.—Columbia University Pal. Coll. No. 19936.

Atoka formation (surface outcrop), along creek, N½ sec. 11, T. 5 N., R. 21 E., Latimer County, Oklahoma.

This species is very abundant at the type locality, where it shows a wide range of variation in external appearance.

Genus TUBERITINA, new genus

Genoholotype *Tuberitina bulbacea*, new species. (Pennsylvanian, Upper Glenn, four miles south of Ardmore, Oklahoma.)

Test attached in life, probably to plants, by a basal disc from which rises a bulbous chamber; monothalmous or polythalmous; succeeding chambers are attached to the preceding chamber by a disc which is smoothly moulded on the preceding chamber, so that the chambers appear to be connected by thick necks; the chambers may be attached to the top of the preceding ones, making a rectilinear or curvilinear series, or to the sides of the preceding ones, making irregular tests; the chambers increase in size as added, and are filled with clear or granular calcite; there are no foramina connecting the chambers; walls calcareous, thick, completely soluble in acid, very finely but obscurely perforate; surface with conspicuous puncta, each of which corresponds to a smaller perforation, or smooth when calcified; aperture absent. Length,, up to 1.2 mm. Found in shales. Pennsylvanian of Oklahoma.

The test of this genus is in effect a colony of unilocular individuals, each growing fast to the preceding. It is very unusual for a foraminifer, since there are no foramina or apertures. The mural pores are very small and obscure and scarcely visible in thin sections. The tests resemble in shape the sporangia of mildews and other Fungi, and to the Algae *Ovulites* and *Corallina*, but the calcareous, perforate walls more resemble Foraminifera.

Species of this genus have been included under *Archaelagena* by Harlton (Journ. Pal., vol. 1, 1927, p. 24).

TUBERITINA BULBACEA, n. sp.

Plate 45, figs. 8 *a-d*

Test monothalmous or more usually composed of from two to four bulbous chambers separated by thick necks, in a uniserial arrangement; wall hyaline, opaque when calcified, obscurely perforate; sur-

face punctate or smooth. Diameter of chamber, 0.17 to 0.4 mm.; length of chamber, 0.27 to 0.6 mm.; length of test, up to 1.3 mm.

Holotype.—Columbia University Pal. Coll. No. 19937.

Upper Glenn (surface outcrop), SW¼ of SW¼ of NW¼ of sec. 20, T. 5 S., R. 1 E., Carter County, Oklahoma, about four miles north of Ardmore.

This species is very widespread both in Oklahoma and Texas, and is found in the lower and middle Pennsylvanian.

Family ENDOTHYRIDAE Rhumbler, 1895

Genus ENDOTHYRA Phillips, 1846

Genotype (monotypic) *Endothyra bowmani* PHILLIPS, Rep. Proc. Geol. Poly. Soc. W. R. Yorkshire, 1844-45 (1846), p. 277, pl. 7, fig. 1. (Lower Carboniferous, Yorkshire, England.)—BRADY, Pal. Soc. Mono., 1876, p. 92, pl. 5, figs. 1-4.—MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 25, no. 9, 1878, p. 96, pl. 4, fig. 3; pl. 12, fig. 2.

Test free, spiral, nautiloid, bilaterally unsymmetrical; whorls few, embracing nearly to umbilicus; chambers inflated, about as long as broad, with deep, radial sutures; edge broadly rounded; wall calcareous, thick, opaque, imperforate, without or with inner, meshwork layer, not of agglutinated particles; aperture a narrow or high, arched slit at the base of the septal face, near the inner periphery. Diameter, up to 1.5 mm. Shallow water sediments, limestones and shales. Mississippian abundant; Pennsylvanian to Triassic rare.

ENDOTHYRA AMERADAENSIS Harlton

Plate 45, figs. 9 *a-c*

Endothyra ameradaensis HARLTON, Journ. Pal., vol. 1, no. 1, 1927, p. 19.

Test small, nautiloid, nearly bilaterally symmetrical; chambers globular, about 10 in the last formed whorl, gradually enlarging; sutures depressed, radial; umbilici large, in which some of the chambers of the earlier coils are visible; wall calcareous, imperforate; aperture a high, arched opening at the base of the last chamber. Diameter, 0.35 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19939.

Atoka formation, (surface outcrop), along creek, N½ of sec. 11, T. 5 N., R. 21 E., Latimer County, Oklahoma.

This species differs from *Endothyra bowmani* Phillips in the more even size of the chambers and greater symmetry. Our specimens

differ from *Endothyra conspicua* Howchin (Journ. Roy. Micr. Soc., 1888, pt. 2, p. 540, pl. 9, fig. 12) in the much smaller size, his specimens having a diameter up to 1.6 mm.

Family FUSULINIDAE Möller, 1877

Genus OROBIAS Eichwald, 1860

Genotype (first species, here designated) *Orobias antiquior* (ROUILLER and VOSINSKY) = *Nummulina antiquior* ROUILLER ET VOSINSKY, Bull. Soc. Imp. Nat. Moscou, vol. 22, 1849, p. 337, pl. K, figs. 66-78. (Lower Pennsylvanian, Moscovian, Mjatschkowa, near Moscow.)—MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 25, no. 9, 1878, p. 43, pl. 1, fig. 1; pl. 6, fig. 1.—BRADY, Pal. Soc. Mono., 1876, p. 147

Orobias EICHWALD, Lethaea Rossica, vol 1, 1860, p. 352.

Nummulostegina SCHUBERT, Verh. k. k. geol. Reichs., Wien, 1907, p. 212, no species; type, designated by CUSHMAN, 1928, *Nummulostegina velebitana* SCHUBERT, Jahrb. k. k. geol. Reichs., Wien, vol. 58, 1908 (1909), p. 377, fig. 4. (Upper Pennsylvanian, Austria.)

Palaeonummulites SCHUBERT, Jahrb. k. k. geol. Reichs., Wien, vol. 58, 1908, p. 378, not definitely proposed.

Ozawaina LEE, Pal. Sinica, ser. B, vol. 4, fasc. 1, 1927, p. 13.

Test free, lenticular, spiral, involute to axis, nearly bilaterally symmetrical; periphery angled; chambers numerous, short and broad, equitant; septa radial; surface smooth; wall calcareous, thick, imperforate, with or without inner, meshwork layer; without buccal rings (chomata); aperture a curved or V-shaped slit at the base of the last septum, not quite symmetrically placed. Diameter, up to 12 mm. Shallow water sediments. Mississippian and Pennsylvanian.

Orobias differs from *Endothyra* in the lenticular shape, angled edge, and more numerous and narrower chambers. It is shaped like *Camerina* (*Nummulites* of authors), but lacks the labyrinthic canal system and perforate walls of that genus.

In addition to the three new species described below, the following published species should be assigned to *Orobias:*

Nummulina antiquior ROUILLER ET VOSINSKY, Bull. Soc. Imp. Nat. Moscou, vol. 22, 1849, p. 337, pl. K, figs. 66-78. (Lower Pennsylvanian, Moscovian, Mjatschkowa, near Moscow.)

Orobias aequalis EICHWALD, Lethaea Rossica, vol. 1, 1860, p. 353, pl. 22, fig. 16. (Lower Pennsylvanian, Moscovian, Mjatschkowa, near Moscow.)

Endothyra macella BRADY, Pal. Soc. Mono., 1876, p. 98, pl. 5, figs. 13, 14. (Mississippian, British Isles.)

Endothyra radiata BRADY, Pal. Soc. Mono., 1876, p. 97, pl. 5, figs. 10-12. (Pennsylvanian, British Isles and Belgium.)

Endothyra ornata BRADY, Pal. Soc. Mono., 1876, p. 99, pl. 6, figs. 1-4. (Mississippian and Pennsylvanian, British Isles.)

Fusulinella bradyi MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 25, no. 9, 1878, p. 111, pl. 5; pl. 15, fig. 2. (Upper Pennsylvanian, Russia.)

Fusulinella struvii MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 27, no. 5, 1879, p. 22, pl. 2, fig. 1; pl. 5, fig. 4. (Lower Pennsylvanian, Austria.)

Fusulinella crassa MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 27, no. 5, 1879, p. 25, pl. 2, fig. 2. (Pennsylvanian, Russia.)

Fusulinella waageni SCHWAGER, Pal. Indica, ser. 13, vol. 1, no. 7, 1888, p. 990, pl. 128, fig. 10. (Permian, India.)

Endothyra radiata tateana HOWCHIN, Journ. Roy. Micr. Soc., 1888, pt. 2, p. 542, pl. 9, figs. 13-15. (Mississippian, England.)

Nummulostegina velebitana SCHUBERT, Jahrb. k. k. geol. Reichs., Wien, vol. 58, 1908 (1909), p. 377, fig. 4. (Upper Pennsylvanian, Austria.)

Staffella sp. OZAWA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 45, art. 4, 1925, pl. 1, fig. 7. (Upper Pennsylvanian, Spitzbergen.)

Nummulostegina ardmorensis HARLTON, Journ. Pal., vol. 1, no. 1, 1927, p. 26, pl. 5, fig. 10. (Middle Pennsylvanian, Oklahoma, and Texas.)

Endothyra elegans HARLTON, Journ. Pal., vol. 1, no. 1, 1927, p. 20, pl. 3, fig. 1. (Middle Pennsylvanian, Oklahoma and Texas.)

Staffella ciscoensis HARLTON, Journ. Pal., vol. 1, no. 4, 1927, p. 307, pl. 52, fig. 9. (Upper Pennsylvanian, Texas.)

Staffella formosa HARLTON, Journ. Pal., vol. 1, no. 4, 1927, p. 307, pl. 52, fig. 7. (Upper Pennsylvanian, Texas.)

OROBIAS BIUMBONATA, n. sp.

Plate 45, figs. 10 *a-c*

Test nearly equally biconvex, biumbonate; peripheral margin acute; periphery slightly lobulate; chambers about 17 in the last whorl, irregular in size; sutures distinct, limbate of clear shell material, slightly curved toward the umbo; wall calcareous, opaque; aperture a V-shaped opening, at the base of the apertural face. Diameter, 0.44 mm.

Holotype.—Columbia University Pal. Coll. No. 19941.

Wapanucka limestone, (surface outcrop), shale near base of the Wapanucka limestone, quarry, two miles south of Hartshorne, NW¼ of sec. 18, T. 4 N., R. 17 E., Pittsburg County, Oklahoma.

This form differs from *O. radiata* (Brady) in being umbonate, and from *O. ciscoensis* (Harlton) in the less numerous chambers and the more distinct sutures.

OROBIAS CISCOENSIS (Harlton)

Plate 45, figs. 11 *a-c*

Staffella ciscoensis HARLTON, Journ. Pal., vol. 1, no. 4, 1928, p. 307, pl. 52, fig. 9.

Test closely coiled, biconvex; peripheral margin acute or slightly rounded; chambers 25 or more in the last whorl; umbilici depressed; sutures distinct, curved, limbate; wall calcareous, opaque, smooth; aperture a large triangular opening in the apertural face. Diameter, 0.5 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19942.

Atoka formation, (surface outcrop) along creek, N½ of sec. 11, T. 5 N., R. 21 E., Latimer County, Oklahoma.

This species differs from *O. radiata* (Brady) in the greater number of chambers and higher aperture.

OROBIAS RADIATA (Brady)

Plate 45, figs. 12 *a-c*

Involutina radiata BRADY, Rep. Brit. Assoc. (Exeter), 1869, p. 379.
Endothyra radiata BRADY, Pal. Soc. Mono., 1876, p. 97, pl. 5, figs. 10-12.

Test planispiral, involute, discoidal, unequally biconvex, with small umbilici; periphery acute or slightly rounded; chambers about 16 in the last whorl; sutures distinct, of clear shell material, slightly curved; wall calcareous, minutely granular, consisting of a thin, dark, outer layer and a thicker, lighter-colored inner layer; surface smooth; aperture a narrow slit at the base of the apertural face. Diameter, 0.4 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19943.

Wapanucka limestone, (surface outcrop), shale near base of Wapanucka limestone, quarry, two miles south of Hartshorne, NW¼ of sec. 18, T. 4 N., R. 17 E., Pittsburg County, Oklahoma.

OROBIAS OKLAHOMAENSIS, n. sp.

Plate 46, figs. 1 *a-c*

Test small, planispiral, discoidal, involute to umbos; edge slightly rounded; chambers about 8 in the last whorl; sutures depressed, not limbate; wall calcareous, consisting of a dark, thin, inner layer and a lighter colored, thick outer layer; aperture large triangular opening in the apertural face. Diameter, 0.44 mm.

Holotype.—Columbia University Pal. Coll. No. 19944.

Upper Glenn, (surface outcrop), SW¼ of SE¼ of sec. 12, T. 6 S., R. 1 E., Love County, Oklahoma, about seven miles south of Ardmore.

OROBIAS VELEBITANA (Schubert)

Plate 46, figs. 2 *a*, *b*

Nummulostegina velebitana SCHUBERT, Jahrb. k. k. geol. Reichs., Wien, vol. 58, 1908 (1909), p. 377, fig. 4. (Upper Pennsylvanian, Austria.)
Endothyra elegans HARLTON, Journ. Pal., vol. 1, no. 1, 1927, p. 20, pl. 3, fig. 1.

Test planispiral, discoidal, biconvex, with very slight or no umbilici; edge angled or narrowly rounded; periphery very little lobulate; chambers 20 to 22 in the last whorl; sutures distinct, of clearer shell material, curved, very little depressed; wall calcareous, opaque, finely granular; aperture a curved slit at the base of the last septum. Diameter, 1 mm.

Plesiotype.—Columbia University, Pal. Coll. No. 19946.

Upper Gaptank formation, one and a half miles northeast of Wolfcamp, Pecos County, Texas.

The Texas specimens agree in all essential features with Schubert's Austrian species. The figured specimen is slightly distorted.

OROBIAS WAAGENI (Schwager)

Plate 46, figs. 3 *a*, *b*

Fusulinella waageni SCHWAGER, Pal. Indica, ser. 13, vol. 1, 1888, p. 990, pl. 128, fig. 10.

Test planispiral, nautiloid, biconvex, involute, not umbilicate; edge broadly angled; periphery very slightly lobulate; chambers 14 to 15 in the last whorl; sutures distinct, slightly depressed and curved; wall calcareous, finely granular and homogeneous as seen in thin sections; aperture a large, curved slit at the base of the apertural face. Diameter, 0.8 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19945.

Belle City limestone (surface outcrop), along road, NE¼ of sec. 8, T. 4 N., R. 6 E., Pontotoc County, Oklahoma, about three miles north of Ada.

This species is common in the Upper Pennsylvanian of Kansas, Oklahoma, and Texas. It differs from *O. velebitana* (Schubert) in the fewer chambers and less curved sutures. It appears to be identical with Schwager's species from the Permian of India.

OROBIAS BASSLERI, n. sp.

Plate 46, figs. 4 *a*, *b*

Test large and stout, highly involute, biumbonate, unequally or equally convex, nearly circular in side view; edge sharp; periphery

slightly lobulate; chambers about 34 in the last whorl, in 4 or 5 whorls; sutures distinct and depressed, radial, slightly curved or straight; wall calcareous, thick, homogeneous, imperforate as seen in thin sections; aperture a narrow slit occupying nearly the entire apertural face. Diameter, 1.8 mm.

Holotype.—Columbia University Pal. Coll. No. 19947.

Upper Glenn (surface outcrop), SW¼ of SE¼ of SE¼ of sec. 12, T. 6 S., R. 1 E., Love County, Oklahoma, about seven miles south of Ardmore.

The large size with the many chambers, very distinct and depressed sutures and high umbos make this form easily recognized. It is distinguished from *O. ardmorensis* (Harlton) (Journ. Pal., vol. 1, no. 1, 1927, p. 26, pl. 5, fig. 10) by the greater number of chambers.

Genus STAFFELLA Ozawa, 1925

Genoholotype *Staffella spherica* (ABICH) = *Fusulina spherica* ABICH, Mém. Acad. Imp. Sci. (Math. Phys.) St. Pétersbourg, ser. 6, vol. 7, 1858 (1859), pp. 439, 528, pl. 3, fig. 12. (Pennsylvanian, Armenia.)—*Fusulinella spherica* MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 25, no. 9, 1878, p. 114, pl. 5, fig. 6; pl. 15, fig 3; topotypes

Staffella OZAWA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 45, art. 4, 1925, p. 24; ibid., art. 6, p. 14.

Test nautiloid or spheroidal, planispirally coiled, the axial diameter the shorter at all stages; chambers numerous, short and broad; whorls embracing to axis; wall calcareous, thick imperforate, with or without meshwork layer; septa primary meridional only, nearly

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EXPLANATION OF PLATE 46

FIGS. 1 *a–c.*—*Orobias oklahomaensis*, n. sp. ×35. *a*, side view; *b*, apertural view; *c*, median section.

2 *a, b.*—*Orobias velebitana* (Schubert). ×25. *a*, side view; *b*, apertural view.

3 *a, b.*—*Orobias waageni* (Schwager). ×35. *a*, side view; *b*, apertural view.

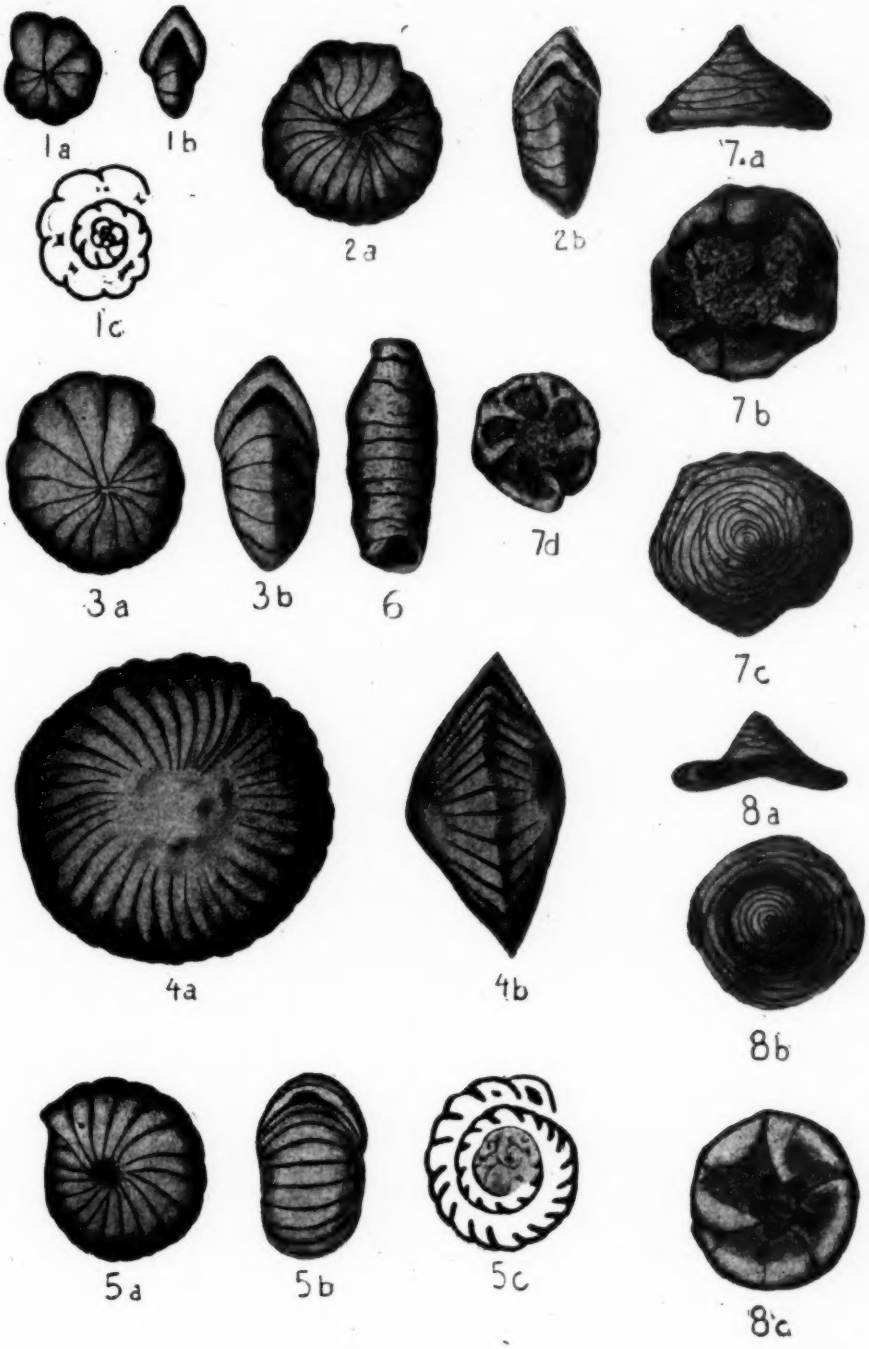
4 *a, b.*—*Orobias bassleri*, n. sp. ×23. *a*, side view; *b*, apertural view.

5 *a-c.*—*Staffella mölleri* Ozawa. ×25. *a*, side view; *b*, apertural view; *c*, median section of a specimen with early whorls destroyed.

6.—*Stacheia marginulinoides* Brady. ×18.

7 *a–d.*—*Tetrataxis maxima* Schellwien. ×35. *a*, side view; *b*, ventral view; *c*, dorsal view; *d*, ventral view of different specimen.

8 *a–c.*—*Tetrataxis maxima* var. *depressa* Schellwien. ×30. *a*, side view; *b*, dorsal view; *c*, ventral view.


1a
1b
1c
2a
2b
7a
7b
7c
7d
3a
3b
6
4a
4b
8a
8b
8c
5a
5b
5c

straight; buccal rings (chomata) enclose a spiral tunnel; aperture single, large, at the base of the septum in the equatorial plane. Equatorial diameter, up to 4.5 mm.; axial diameter, up to 3.6 mm. In limestone mostly. Mississippian (?), Pennsylvanian and Permian.

Staffella differs from *Orobias* in the longer axis, round periphery, and chomata; from *Fusulinella* in the shorter axis and lack of vesicular structure at the axial extremities.

STAFFELLA MÖLLERI Ozawa

Plate 46, figs. 5 *a-c*

Staffella mölleri OZAWA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 45, art. 6, 1925, p. 19, pl. 2, fig. 9.

Test nautiloid, nearly circular in side view, highly involute, slightly umbilicate, the axial diameter about 0.6 of the median diameter; chambers 18 to 21 in the last whorl; sutures distinct, limbate, even with the surface; wall calcareous, thick, homogeneous or fibrous with indications of meshwork; septa not folded, thickened on both sides of the aperture forming chomata which enclose a spiral tunnel; tunnel about one-third the breadth of the chamber; aperture a narrow slit at the base of the septum, increasing in height at the opening of the tunnel. Axial diameter, 0.6 mm.; median diameter, 1 mm.

Plesiotype.—Columbia University Pal Coll. No. 19948.

Upper Glenn (surface outcrop), SW¼ of SE¼ of sec. 12, T. 6 S., R. 1 E., Love County, Oklahoma, about seven miles south of Ardmore.

This species differs from *Staffella spherica* (Abich) in lacking the strong ridge around the umbilicus, and from *Staffella spheroidea* (Ehrenberg) in the shorter axis and in that it is umbilicate.

Family DOUBTFUL

Genus TETRATAXIS Ehrenberg, 1843

Genotype (monotypic) *Tetrataxis conica* EHRENBERG, Bericht k. preuss. Ak. Wiss. Berlin, 1843, p. 106; Mikrogeologie, 1854, p. 37, pt. 11, fig. 12. (Lower Pennsylvanian, *Spirifer mosquensis* zone, Tula, Russia.)—MÖLLER, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 27, no. 5, 1879, p. 71, pl. 2, fig. 3; pl. 7, figs. 1, 2; topotypes.

Valvulina (part) BRADY, Pal. Soc. Mono., 1876, p. 83.

Test free, rarely attached, trochoid, spiral, composed of many closely appressed chambers which are long and narrow, and from 3 to 9 or more to a whorl; base of test flat or concave, with typically four-lobed umbilicus, suggesting the name *Tetrataxis;* chambers not

divided into chamberlets; walls calcareous, not arenaceous or agglutinated, thick, on the conical side of the test finely granular and dark, on the apertural side hyaline and fibrous or alveolar, much as in *Fusulina;* aperture opening into the umbilicus. Diameter, up to 4 mm. Shallow water deposits. Mississippian of British Islands and Belgium; Pennsylvanian of British Islands, Russia, Iowa, Nebraska, Oklahoma, Texas and Michigan; Permian of Japan.

In thin sections under the petrographic microscope the outer wall is granular and purely calcareous, like crystalline limestone. The walls on the lower side of the test are clear, fibrous and alveolar, and grade upward into granular material.

TETRATAXIS MAXIMA Schellwien

Plate 46, figs. 7 *a-d*

Tetrataxis maxima SCHELLWIEN, Palaeontographica, vol. 44, pt. 2, 1898, p. 274, pl. 24, figs. 5-10.

Test free, conical with concave base and pointed apical end; chambers usually about 7 in the last whorl; sutures little depressed, and obscure on both sides of the test; surface smooth; aperture opening into the umbilicus, in nepionic forms covered with a valvular flap; chambers on the ventral side separating in later stages and forming a broad central space, from which radiate grooves, and into which open the narrow apertures. Diameter of figured specimen, 0.8 mm.; height, 0.44 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19950.

Wapanucka limestone (surface outcrop), shale near base of Wapanucka limestone, quarry, two miles south of Hartshorne, NW¼ of sec. 18, T. 4 N., R. 17 E., Pittsburg County, Oklahoma.

This species is very common at the above locality, and is characteristic of the Lower Pennsylvanian of Oklahoma.

Ephebic stages of this species and of *T. conica* Ehrenberg can be easily separated, but the exteriors of the nepionic forms exactly resemble each other. By means of longitudinal sections the nepionic form of this species can be distinguished without difficulty, as the whorls are very much fewer, and the succeeding whorls are comparatively higher. The chambers in the last whorls do not have a much greater volume than those of *T. conica,* because each whorl has many more chambers. The increase in number of chambers starts with the fifth or sixth whorl, while preceding whorls mostly show four chambers, similar to *T. conica.* From the fifth or sixth whorl on the number of chambers gradually increases to as many as twelve.

TETRATAXIS MAXIMA var. DEPRESSA Schellwien

Plate 46, figs. 8 *a-c*

Tetrataxis maxima var. *depressa* SCHELLWIEN, Palaeontographica, pt. 2, 1898, p. 275, pl. 24, figs. 11 *a, b.*

This variety is almost flat, but can readily be recognized because the first whorls appear in the form of a cone over a slightly sloping or flat base. It is connected with the species by a number of intermediate stages. Young specimens have only four chambers to a whorl, as in the figured example. Diameter of figured specimen, 0.78 mm.; height, 0.34 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19951.

Wapanucka limestone (surface outcrop), shale near base of Wapanucka limestone, quarry, two miles south of Hartshorne, NW¼ of sec. 18, T. 4 N., R. 17 E., Pittsburg County, Oklahoma.

Family DOUBTFUL

Genus STACHEIA Brady, 1876

Genotype (first species, designated by CUSHMAN, 1927) *S. marginulinoides* BRADY, Pal. Soc. Mono., 1876, p. 107, pl. 7, figs. 16-21. (Lower Carboniferous, England.)

Test free or attached at the initial end or adherent and conforming to the shape of the host, elongate; chambers numerous, uniserial, each chamber partially embracing the preceding one, and divided into chamberlets by septa which are at right angles to the upper wall of the chamber; wall finely arenaceous, agglutinated, with siliceous cement, imperforate; aperture terminal, single. Length, up to 3 mm. Shallow water sediments. Mississippian of England; Pennsylvanian of Oklahoma.

Stacheia is one of the few Paleozoic genera in which the wall is agglutinated.

STACHEIA MARGINULINOIDES Brady

Plate 46, fig. 6

Stacheia marginulinoides BRADY, Pal. Soc. Mono., 1876, p. 112, pl. 7, figs. 16-21.

Test free or possibly attached at the lower end, pyriform, elongate, straight or curved, round in cross section; chambers 6 to 10, gradually enlarging, closely appressed; sutures distinct, crenulate, slightly

depressed; wall finely arenaceous, imperforate and insoluble in acid; surface smooth; aperture terminal, round. Length, 2 mm.

Plesiotype.—Columbia University Pal. Coll. No. 19949.

Wapanucka limestone (surface outcrop), shale near base of Wapanucka limestone, quarry, two miles south of Hartshorne, NW¼ of sec. 18, T. 4 N., R. 17 E., Pittsburg County, Oklahoma.

This species is characteristic of the basal Pennsylvanian of Oklahoma, and has also been found in the Caney shale.

UPPER PALEOZOIC FORAMINIFERA FROM SUTTON COUNTY, TEXAS

By JOSEPH A. CUSHMAN and JAMES A. WATERS

ABSTRACT

The interesting series of foraminifera from this well in Sutton County, Texas, comes from the Upper Pennsylvanian and Lower Permian. There are many new forms and others recently described from surface outcrops. The more primitive arenaceous forms are apt to be distorted but the calcareous forms are more resistant.

The foraminifera included in the present paper are from the Upper Pennsylvanian and the Lower Permian of Sutton County, Texas. They are from well samples taken from Ross No. 1 Well of the National Potash Company. As these foraminifera include some very interesting forms, some of which have recently been described from equivalent formations of Texas and many that are new, it seems wise to place the results of this study on record that they may be available for those studying duplicates of these same well samples or of other formations of equivalent age of the same general region.

The actual depth from which the type specimens were taken is given, but the vertical range of these is not fully worked out here. Some of the species represent very interesting forms specially those placed under the new genus *Spandelina*. They show the development of forms very similar to some of the genera of the Lagenidae, but their development comes directly from such forms as *Geinitzina* and *Monogenerina*. The early stages especially of the microspheric form show well this relationship. The aperture is round and terminal, but is not radiate nor does it have the apertural chamber so characteristic of the true Lagenidae. They represent examples of parallelism such as are found in many of the other groups of the foraminifera. The

series shows well the development of perforate, calcareous forms from agglutinated ones. Some of the samples show the peculiar fauna that has already been described from the Dothan limestone, and includes a number of genera and species already described from that formation.

There are other species, but not noted here, which are represented by specimens either too few in number to accurately determine microspheric and megalospheric forms or in which specimens are not complete. Such have been left out until better suites of specimens may be obtained. The following species have been noted in the material:

Family HYPERAMMINIDAE

Genus HYPERAMMINOIDES Cushman and Waters, 1928

HYPERAMMINOIDES GLABRA (Cushman and Waters)

Plate 47, figs. 1, 2

Nodosinella glabra CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 147, pl. 26, figs. 4, 5.

Numerous specimens of this species occur in the sample from 1013-1026 feet. They are like typical specimens of the Cisco from outcrop samples. The species probably has a considerable vertical range.

Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS SEMICONSTRICTUS Waters, var. REGULARIS Waters

Plate 47, figs. 3-5

Ammodiscus semiconstrictus WATERS, var. *regularis* WATERS, Journ. Pal., vol. 1, no. 2, 1927, p. 132, pl. 22, figs. 2 *a*, *b*.

Fig. 3 probably represents the young stage of this variety, and figs. 4 and 5 collapsed adults. The coiled chamber increases rather uniformly in diameter but the wall is fairly thin with much chitin and collapses easily. The form has a wide vertical range.

Family LITUOLIDAE

Genus ENDOTHYRA Phillips, 1846

ENDOTHYRA ROTUNDA Cushman and Waters, n. sp.

Plate 47, figs. 9 *a*, *b*

Test close coiled, completely involute, periphery broadly rounded; chambers 8 or 9 in the last-formed coil, not inflated; sutures not depressed, somewhat indistinct; wall smoothly finished, the outer coating thin; aperture very broad, extending from one umbilicus to the other and of nearly uniform height.

Diameter 0.50 mm.

Holotype (Cushman Coll. No. 9613) from sample from 801-801½ feet, National Potash Co., Ross. No. 1 Well, Sutton Co., Texas.

This is a very rounded form with a large wide aperture.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES SUTTONENSIS Cushman and Waters, n. sp.

Plate 47, figs. 6 *a*, *b*

Test much compressed, early portion closely coiled, later portion uncoiled, constricted toward the apertural end, early coiled portion with 7-8 chambers somewhat irregular in shape, uncoiled portion usually with several compressed chambers; wall coarsely arenaceous, of clear, angular grains with a comparatively small amount of cement; aperture elongate, elliptical, terminal.

Length of type specimen 0.80 mm.; breadth 0.45 mm.

EXPLANATION OF PLATE 47

FIGS. 1, 2.—*Hyperamminoides glabra* (Cushman and Waters). ×80.

3–5.—*Ammodiscus semiconstrictus* Waters, var. *regularis* Waters. ×65.

6.—*Ammobaculites suttonensis* Cushman and Waters, n. sp. ×65. *a*, side view; *b*, apertural view.

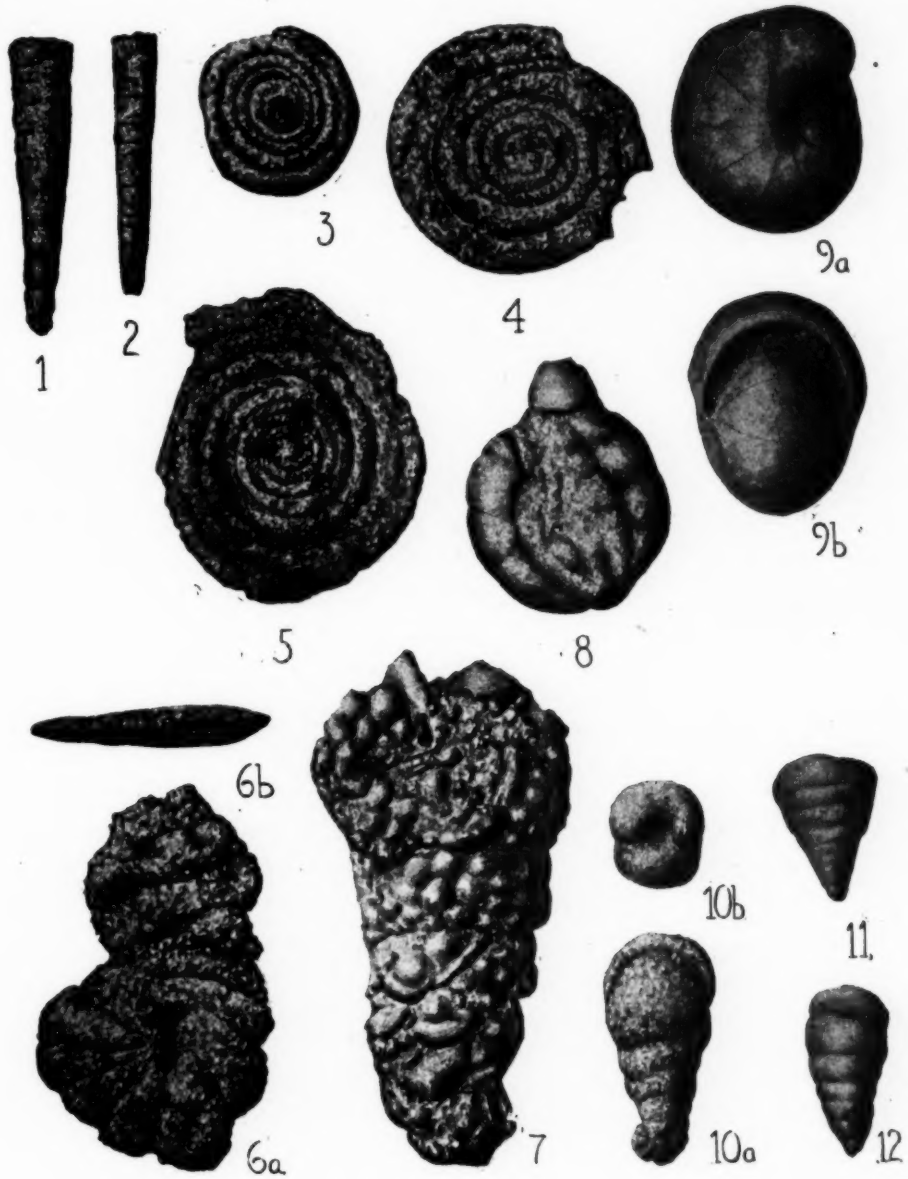
7.—*Ammobaculites texturata* Cushman and Waters, n. sp. ×50.

8.—*Ammobaculites powersi* Harlton. ×50.

9.—*Endothyra rotunda* Cushman and Waters, n. sp. ×65. *a*, side view; *b*, apertural view.

10.—*Spiroplectammina suttonensis* Cushman and Waters, n. sp. ×65. *a*, side view; *b*, apertural view.

11, 12.—*Geinitzina ciscoensis* Cushman and Waters. ×65.


1
2
3
4
9a
5
8
9b
6b
6a
7
10b
11
10a
12

Holotype (Cushman Coll. No. 9615) from sample from 764 feet, National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This is a much compressed species rather constant in its general characters. It is unlike any of the other described species from the Palaeozoic.

AMMOBACULITES TEXTURATA Cushman and Waters, n. sp.

Plate 47, fig. 7

Test comparatively large, very little compressed, the early chambers coiled, making usually only a single coil or less; chambers fairly distinct, usually 4-6 in the uncoiled portion, increasing slightly in size as added; sutures depressed; wall thick, very coarsely arenaceous, of rounded or angular grains, very firmly cemented; aperture rounded, terminal.

Length of holotype 1.35 mm.; breadth 0.75 mm.

Holotype (Cushman Coll. No. 9620) from sample from 645 feet from National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This is a large coarse species with a thick wall, fairly common at this particular horizon.

AMMOBACULITES POWERSI Harlton

Plate 47, fig. 8

Ammobaculites powersi HARLTON, Journ. Pal., vol. 1, 1927, p. 21, pl. 3, figs. 3 *a-e*.

This species is well developed in the upper Pennsylvanian. The figured specimen has the central portion somewhat covered, but shows the general shape of the species. It is from a sample taken at 879 feet.

Family TEXTULARIIDAE

Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA SUTTONENSIS Cushman and Waters, n. sp.

Plate 47, figs. 10 *a*, *b*

Test small, the early portion somewhat compressed and close coiled, planispiral, later portion uncoiled and biserial; chambers distinct, about five pairs in the uncoiled portion, increasing in size as added, the last-formed ones the largest of the series, inflated; sutures distinct, depressed; wall arenaceous with much cement, rather

smoothly finished; aperture deep, in a reëntrant of the apertural face of the last-formed chamber.

Length 0.45 mm.; breadth 0.23 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 9621) from sample from 778-785 feet, National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This is a very definite species with its definitely spiral early stages and nearly quadrate end view.

Many of the specimens are considerably crushed and distorted.

Genus GEINITZINA Spandel, 1901

GEINITZINA CISCOENSIS Cushman and Waters

Plate 47, figs. 11, 12

Geinitzina ciscoensis CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 63, pl. 8, figs. 6 *a*, *b*.

Specimens apparently of this species are fairly common in the well samples. They are small, often not more than 0.30 mm. in length.

Genus MONOGENERINA Spandel, 1901

MONOGENERINA TEXANA Cushman and Waters, n. sp.

Plate 48, figs. 1, 2

Test minute, elongate, tapering, uniserial, compressed, periphery rounded; chambers distinct, slightly inflated, symmetrical, low and broad, somewhat depressed in the median line; sutures distinct, depressed, somewhat arched in the central region; wall smooth, perforate; aperture elongate, elliptical with a slight lip.

Length 0.40 mm.; breadth 0.18 mm.; thickness 0.06 mm.

Holotype (Cushman Coll. No. 9625) from samples from 934-941 feet from National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This is a small but distinct species showing well the relations between *Monogenerina* and *Geinitzina*. Fig. 2 shows the megalospheric form, and fig. 1 the microspheric form of the same species. The latter is much more slender but has many more chambers and reaches a greater length.

Genus SPANDELINA Cushman and Waters, new genus

Genoholotype *Spandelina excavata* CUSHMAN and WATERS, n. sp.

Test uniserial, the chambers in a generally rectilinear series, the earlier ones at least compressed in typical forms especially in the

microspheric form; sutures usually distinct and compressed, in the early stages, at least of the microspheric form obliquely slanting back from the central region; wall calcareous, perforate; aperture single, terminal, elliptical or rounded.

The various forms of this genus appear at first glance to be allied to the Lagenidae but their source is evidently from *Geinitzina* and *Monogenerina*. The compression of the early stages in the microspheric form makes that stage close to these two genera. Later, various forms are assumed, but there is no evidence of any of them having a coiled young stage and the specialization has been carried so far that the biserial stage also is lost even in the microspheric young. Such forms evidently carried over into the Triassic and Jurassic where very similar forms occur. These late Pennsylvanian and Permian forms are examples of parallelism and show another example of the many lines of development that have assumed *Nodosaria*-like forms in their later stages.

SPANDELINA EXCAVATA Cushman and Waters, n. sp.

Plate 48, figs. 3, 4

Test elongate, tapering, greatest width made by the last-formed chamber, much compressed throughout, the median portion excavated, periphery rounded; chambers numerous, 9-10 in number, distinct, slightly inflated; sutures obliquely slanting backward from the

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EXPLANATION OF PLATE 48

FIGS. 1, 2.—*Monogenerina texana* Cushman and Waters, n. sp. ×80. *a*, front view; *b*, apertural views. 1, microspheric form; 2, megalospheric form.

3, 4.—*Spandelina excavata* Cushman and Waters, n. sp. ×80. *a*, front view; *b*, apertural views.

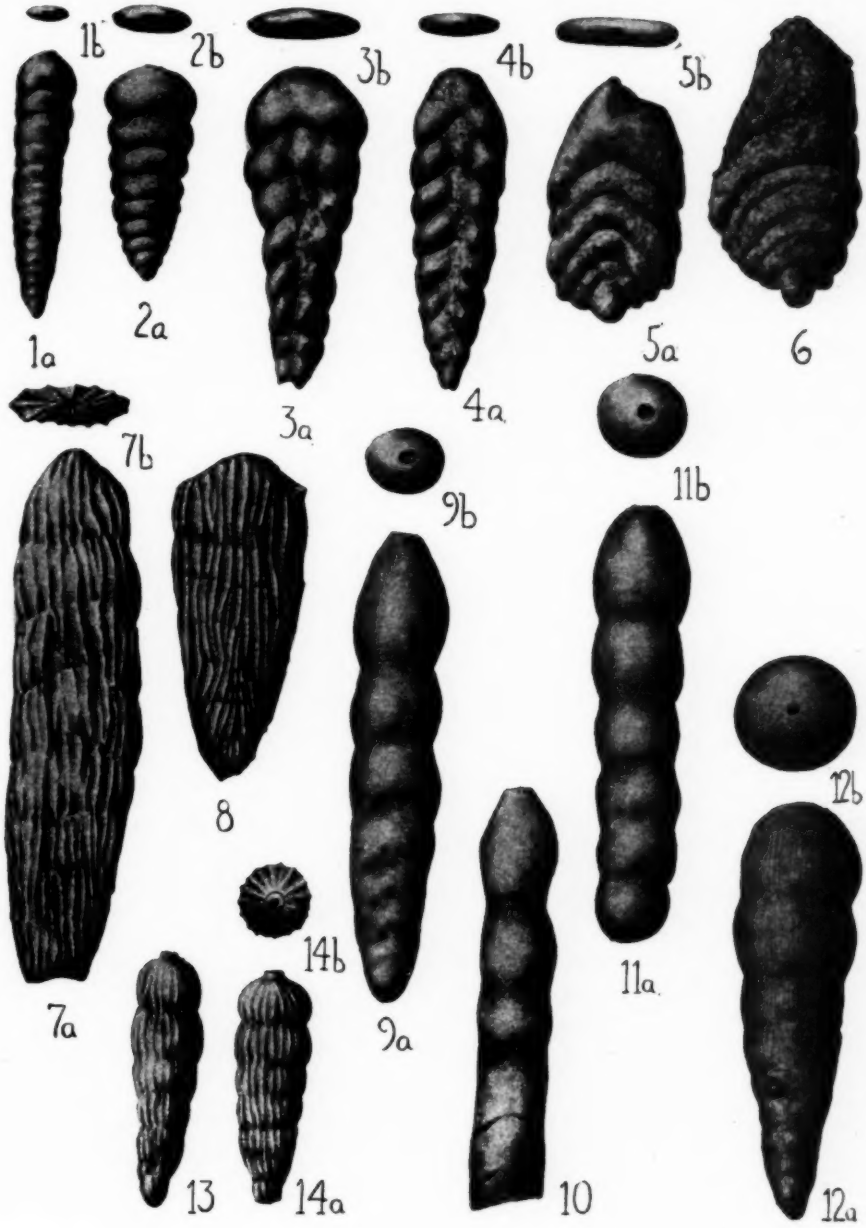
5, 6.—*Spandelina texana* Cushman and Waters, n. sp. ×65. *a*, front view; *b*, apertural view.

7, 8.—*Spandelina fissicostata* Cushman and Waters, n. sp. ×65. *a*, front view; *b*, apertural view.

9–11.—*Spandelina (Spandelinoides) nodosariformis* Cushman and Waters, n. sp. ×65. *a*, front view; *b*, apertural view. 9, 10, microspheric forms; 11, megalospheric form.

12.—*Spandelina (Spandelinoides) striatella* Cushman and Waters, n. sp. ×65. *a*, front view; *b*, apertural view.

13, 14.—*Spandelina (Spandelinoides) striato-clavata* (Spandel). ×65. *a*, front viwe; *b*, apertural view.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center toward the periphery, depressed; wall calcareous, perforate, unornamented; aperture small, narrowly elliptical, terminal.

Length 0.50 mm.; breadth 0.20 mm.; thickness 0.04 mm.

Holotype (Cushman Coll. No. 9626) from sample at 950½-954½ feet, National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This is a small but distinct species.

SPANDELINA TEXANA Cushman and Waters, n. sp.

Plate 48, figs. 5, 6

Test much compressed, about twice as long as broad, the early portion tapering, later portion with the sides nearly parallel; chambers comparatively few, usually 6-7, distinct, considerably overlapping, leaving the visible portion low and broad; sutures distinct, depressed, obliquely slanting backward from the center toward the periphery; wall calcareous, perforate, unornamented; aperture small, narrowly elliptical, terminal.

Length 0.60 mm.; breadth 0.30 mm.; thickness 0.06 mm.

Holotype (Cushman Coll. No. 9628) from sample from 943-950 feet, National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This is a broad, compressed species with low, broad chambers and very oblique sutures.

SPANDELINA FISSICOSTATA Cushman and Waters, n. sp.

Plate 48, figs. 7, 8

Test elongate, much compressed, early portion tapering, the greater part of the test with the sides parallel, periphery subacute; chambers numerous, much obscured by the surface ornamentation; sutures somewhat indistinct, slanting obliquely backward from the center; wall calcareous, perforate, ornamented by distinct raised costae which are often divided and anastomosing; aperture small, elongate-elliptical, terminal.

Length up to 1.20 mm.; breadth 0.30 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 9630) from sample from 778-783 feet, National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

In some respects this resembles Jurassic species usually assigned to *Lingulina* or *Frondicularia*, but the aperture is not radiate and the early stages are not coiled even in the microspheric form in these Palaeozoic specimens.

Subgenus SPANDELINOIDES Cushman and Waters, new subgenus

Subgenoholotype *Spandelinoides nodosariformis* CUSHMAN and WATERS, n. sp.

Test elongate, consisting of numerous chambers arranged in a rectilinear series, the earlier chambers at least in the microspheric form somewhat compressed, later ones becoming circular in cross section; aperture circular, terminal, sometimes with a lip.

This subgenus is directly derived from the compressed form by the addition of inflated chambers of nodosarian character, the aperture becoming circular at the same time.

SPANDELINA (SPANDELINOIDES) NODOSARIFORMIS Cushman and Waters, n. sp.

Plate 48, figs. 9-11

Test elongate, slender, in the microspheric form with the early portion compressed but later chambers inflated and nodosarian, circular in transverse section; chambers numerous, 8-10 in the adult microspheric form, which has the earlier ones compressed while those of the largest megalospheric forms are often inflated throughout; sutures of the early compressed portion only slightly depressed, obliquely slanting backward from the central region, in the adult becoming more deeply depressed and transverse to the axis of growth; wall smooth; aperture circular in the adult, terminal, often with a slight lip.

Length up to 1.10 mm.; breadth up to 0.20 mm.

Holotype (Cushman Coll. No. 9633) from sample from 778-783 feet from National Potash Co., Ross No. 1 Well, Sutton Co., Texas.

This species shows very well the derivation of these inflated nodosarian forms from the compressed linguline forms but all with the simple apertures. The microspheric form is shown in pl. 48, figs. 9, 10, and the large megalospheric form in pl. 48, fig. 11.

SPANDELINA (SPANDELINOIDES) STRIATO-CLAVATA (Spandel)

Plate 48, figs. 13, 14

Nodosaria striato-clavata SPANDEL, Verl. Verl.-Instit., "General-Anzeiger", Nürnberg, 1898, p. 9, text fig. 6.

Test elongate, tapering, greatest width near the apertural end, circular in transverse section except slightly compressed in the very early stages of the microspheric form; chambers usually about seven in the megalospheric form, inflated; sutures depressed, distinct; wall ornamented with a few longitudinal raised costae about twenty in

the whole circumference of the chamber and continuous from chamber to chamber; aperture circular, terminal with a distinct lip.

Length 0.50 mm.; breadth 0.15 mm.

Holotype (Cushman Coll. No. 9632) from sample from 822½-833½ feet from National Potash Co. Ross No. 1 Well, Sutton Co., Texas.

This is very close to the figure given by Spandel for his species, and until more is known of his type, may be placed under Spandel's species. It is a rather beautifully ornamented species and very constant in its characters.

SPANDELINA (SPANDELINOIDES) STRIATELLA Cushman and Waters, n. sp.

Plae 48, figs. 12 *a*, *b*

Test elongate, tapering, greatest width near the apertural end, circular in transverse section; chambers about ten in number, inflated but much overlapping; sutures distinct but not deeply depressed; wall with fine longitudinal striae; aperture small, circular, terminal.

Length 0.85 mm.; breadth 0.23 mm.

Holotype (Cushman Coll. No. 9635) from sample from 801-810.5 feet from National Potash Co. Ross No. 1 Well, Sutton Co., Texas.

This may be distinguished from the other species that occur in these samples by the close set chambers, rather rapidly increasing in size and the fine longitudinal striae of the surface.

There are incomplete specimens in the collection that seem to indicate that other species are present, but they are not sufficiently well preserved nor complete enough to warrant specific description at the present time.

EXPLANATION OF PLATE 49

All figures ×65

FIGS. 1, 2.—*Hemigordius harltoni* Cushman and Waters. Fig. 1, Young megalospheric form. Fig. 2, Large microspheric form.

3.—*Cornuspira thompsoni* Cushman and Waters.

4.—*Orthovertella protea* Cushman and Waters.

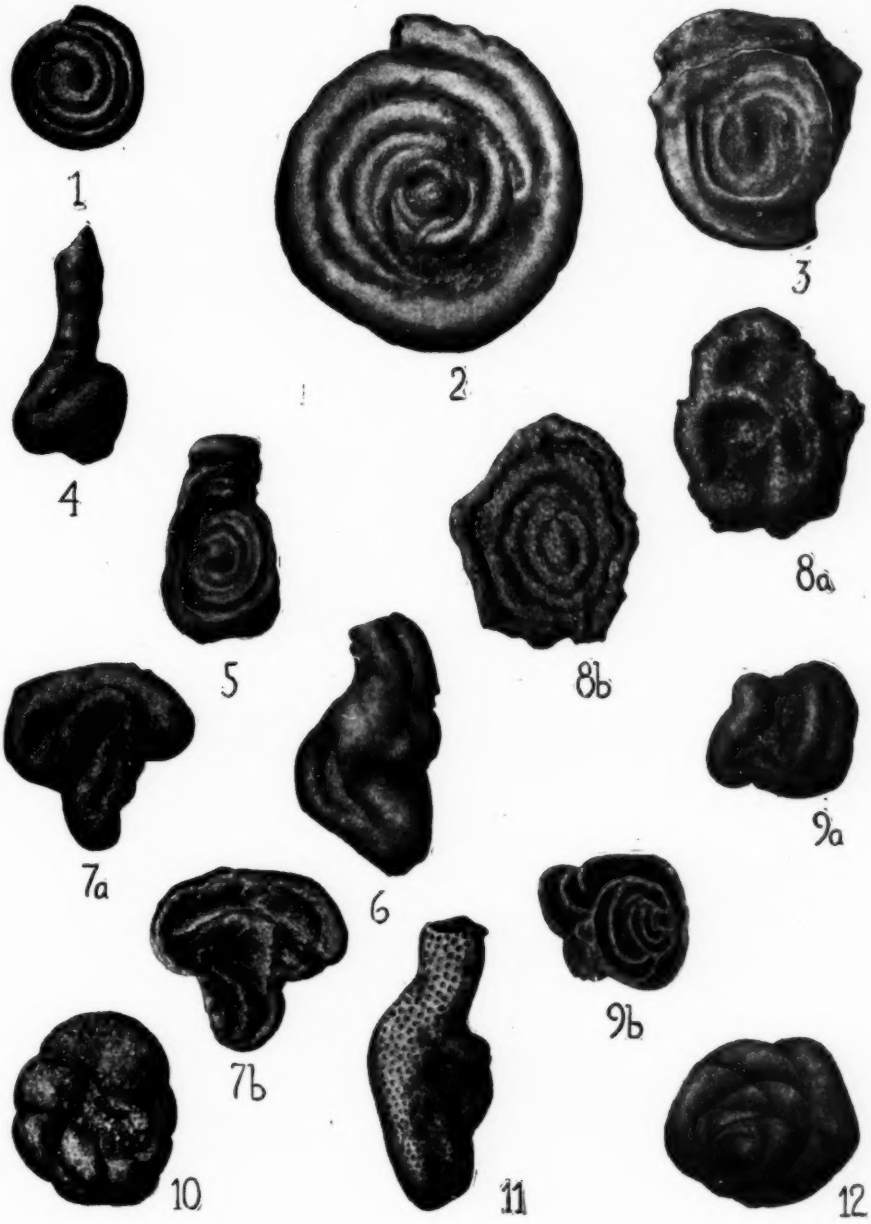
5, 6.—*Calcitornella elongata* Cushman and Waters. Fig. 5, Ventral side. Fig. 6, Dorsal side.

7–9.—*Calcitornella heathi* Cushman and Waters. *a*, dorsal side; *b*, ventra side.

10.—*Trochammina* sp.?

11.—*Apterinella grahamensis* (Harlton).

12.—*Tetrataxis corona* Cushman and Waters.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Family OPHTHALMIDIIDAE

Genus HEMIGORDIUS Schubert, 1908

HEMIGORDIUS HARLTONI Cushman and Waters
Plate 49, figs. 1, 2

Hemigordius harltoni CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 43, pl. 5, figs. 8, 9.

There are specimens from samples 934-941 and 856-859 feet that may be referred to this species. The early coils in the microspheric form are not planispiral although later coils are rather regularly so. Fig. 2 represents a large microspheric specimen with the early coils in various planes. Fig. 1 represents a small megalospheric specimen with large proloculum and the coils nearly in one plane.

This species has a wide range in the upper Pennsylvanian.

Genus CORNUSPIRA Schultze, 1854

CORNUSPIRA THOMPSONI Cushman and Waters
Plate 49, fig. 3

Cornuspira thompsoni CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 44, pl. 5, figs. 10 *a-c*.

There are a few specimens in the sample from 822½-832½ feet which probably belong to this species. They have a slightly keeled periphery and the tubular chamber somewhat compressed.

Genus ORTHOVERTELLA Cushman and Waters

ORTHOVERTELLA PROTEA Cushman and Waters
Plate 49, fig. 4

Orthovertella protea CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 45, pl. 6, figs. 3, 4.

In the sample this species occurs in some numbers, especially from 856-859 feet.

Genus CALCITORNELLA Cushman and Waters, 1928

CALCITORNELLA ELONGATA Cushman and Waters
Plate 49, figs. 5, 6

Calcitornella elongata CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 47, pl. 6, fig. 5.

Specimens of this species occur especially in the sample from 856-859 feet.

CALCITORNELLA HEATHI Cushman and Waters

Plate 49, figs. 7-9

Calcitornella heathi CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 48, pl. 6, figs. 8 *a*, *b*.

There are numerous specimens which may be referred to this species especially in the sample from 856-859 feet. Some of the stages are shown in the figures.

Genus APTERRINELLA Cushman and Waters, 1928

APTERRINELLA GRAHAMENSIS (Harlton)

Plate 49, fig. 11

Tolypammina grahamensis HARLTON, Journ. Pal., vol. 4, 1928, p. 305, pl. 52, fig. 1.

Apterrinella grahamensis CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, pp. 64, 68, pl. 9, figs. 1-4.

Specimens of this species are common especially from the samples from 856-859 feet. The figured specimen shows the early portion of a megalospheric specimen in which the recticulate surface follows closely after the proloculum.

Family TROCHAMMINIDAE

Genus TROCHAMMINA Parker and Jones, 1860

TROCHAMMINA sp.

Plate 49, fig. 10

There are a number of specimens of *Trochammina* from the sample from 778-785 feet which are so badly crushed and deformed that it is difficult to give the full specific characters. A figure of the dorsal side of one of these crushed specimens is here given.

Family ORBITOLINIDAE

Genus TETRATAXIS Ehrenberg, 1843

TETRATAXIS CORONA Cushman and Waters

Plate 49, fig. 12

Tetrataxis corona CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 65, pl. 8, figs. 10 *a*, *b*.

There are young specimens from samples from 856-859 feet which are probably of this species. The figured specimen is evidently a young megalospheric one.

NOTES ON THE TERTIARY FORAMINIFERA OF SOUTHERN MEXICO

By W. L. F. NUTTALL

INTRODUCTION

The Tertiary strata of the central and eastern portions of the Isthmus of Tehuantepec contains an abundant fauna of Foraminifera. The writer is indebted to the Mexican Eagle and Corona Oil Companies for permission granted for the publication of this paper. He wishes to thank Dr. J. A. Cushman for facilities offered in his laboratory, as well as valuable suggestions. It is of interest to record the occurrence of certain species restricted to beds of known age in surrounding regions, as well as describe a few of the more marked new species.

THE MIOCENE AND OLIGOCENE

The Lower Miocene and Oligocene beds are composed of shales and intercalated sandstones, containing the following species which have been recorded only in American Tertiary strata:

Bolivina floridana Cushman, so far recorded from the Miocene of Florida and Trinidad.

Cristellaria vaughani Cushman, described from the Gatun and Culebra Formations of Panama.

Cibicides floridana (Cushman), so far recorded from the Miocene of Florida and Trinidad.

Cibicides americana (Cushman), a species common throughout the Miocene of the Gulf coast, Panama and West Indies.

Cibicides trinitatensis (Nuttall), described from the Miocene and Oligocene of Trinidad.

Siphogenerina raphanus var. *transversus* Cushman, a species found in the Culebra Formation of Panama, the Miocene and Oligocene beds of Trinidad.

Textularia mississippiensis Cushman. The specimens from the Isthmus agree best with forms from the Byram Marl of Mississippi.

Sorites americana (Cushman), originally described from the Culebra Formation of Trinidad.

The beds contain the following two species which are described as new:

Genus CIBICIDES Montfort

CIBICIDES FILISOLAENSIS, sp. nov.

Plate 50, figs. 3-5

Test plano-convex, rotaliform, dorsal side forming a low cone, ventral side flattened. Dorsal surface with ten to twelve chambers visible in the last whorl; sutures raised, limbate, strongly curved, chamber surface coarsely perforate. Border narrow, rounded. Ventrally sutures limbate, much raised; surface elevated at the periphery of the test and also usually near the umbilicus with a circular depression surrounding the umbilical region. Aperture a short curved slit extending over the aperture. Average diameter 0.7 mm.

This species, which is common, is readily recognized by the peculiar structure of the ventral surface, which distinguishes it from other species of the genus.

Genus CHILOSTOMELLA Reuss

CHILOSTOMELLA MEXICANA, sp. nov.

Plate 50, figs. 1, 2

Test smooth, roughly ovoid, slightly compressed, tapering to the broadly rounded basal end. Shell widest at the aperture, this end being somewhat truncated. Test about two thirds as wide as long. Aperture situated a short distance below the upper surface, an elongate slightly curved narrow slit with a narrow lip. Average length 1 mm.

This species is distinguished from *C. ovoidea* Reuss by the truncate nature of the apertural end.

THE UPPER EOCENE

At the top of the Upper Eocene are conglomerates which pass down into indurated shales. These beds contain among others the following species which establish their age:

Asterocyclina bontourana (Hodson), described from the Upper Eocene of Trinidad.

Lepidocyclina (Polylepidina) adkinsi Vaughan, described from the Upper Eocene of Chiapas, Mexico.

Hantkenina mexicana Cushman, *Hantkenina brevispinosa* Cushman, and *Anomalina dorri* Cole, described from the Upper Eocene of Northern Mexico.

The following species are described as new from these beds:

Genus ROTALIA Lamarck

ROTALIA MEXICANA, sp. nov.

Plate 50, figs. 6-8

Test plano-convex to slightly biconvex, the dorsal side strongly convex and the ventral flattened. Dorsal surface smooth, covered with shell growth so that the chambers are not visible externally. Ventral surface irregularly granular, the umbilical area filled with a rounded flattened boss of shell substance surrounded by eleven to thirteen radiate chambers. Each chamber is extended at its periphery into a short blunt point and is separated from its neighbour by a narrow depressed suture. The chambers increase in length very gradually. Aperture a very narrow elongate slit, extending from the junction of the last chamber with the central boss to near the rounded periphery. An equatorial section showed two whorls with eleven chambers in the last whorl. The sutures were composed of a single gently curved lamina and the chamber-walls were thick and double. A transverse section showed that the basal boss only extended a short distance into the test. Maximum diameter 1.1 mm.

This species resembles *R. lithothamnica* Uhlig and other of the more complex Rotalias.

EXPLANATION OF PLATE 50

FIGS. 1, 2.—*Chilostomella mexicana*, sp. nov. Fig. 1, Front view, from Filisola Well 82, depth 2794 feet. Fig. 2, Apertural view, from Filisola Well 82, depth 2667 feet.

3–5.—*Cibicides filisolaensis*, sp. nov. Filisola Well 11, depth 620 to 630 feet. Fig. 3, Dorsal view. Fig. 4, Ventral view. Fig. 5, Apertural view of same specimen as last.

6–8.—*Rotalia mexicana*, sp. nov. Tigres i Changos, S. W. of La Laja, Pedregal River. Fig. 6, Side view. Fig. 7, Ventral view. Fig. 8, Dorsal view of same specimen as in Fig. 6.

9–11.—*Hastigerinella eocanica*, sp. nov. Upper Uzpanapa River, ½ km. north of Numeracion Island.

All specimens are multiplied by 32, and the types deposited in Dr. J. A. Cushman's collection.

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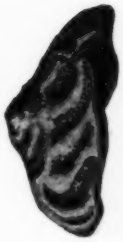

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Genus HASTIGERINELLA Cushman

HASTIGERINELLA EOCANICA, sp. nov.

Plate 50, figs. 9-11

Test with earlier portion trochoid, later development planispiral. Earlier chambers globigeriniform, later chambers elongate with rounded smooth extremities. Aperture not preserved in the specimens examined. Average length 0.7 mm.

This species is readily distinguished from *H. digitata* (Rhumbler), the only other described species of the genus. The latter bears spines on the end of the later chambers.

SOME NEW PENNSYLVANIAN OSTRACODA

H. N. CORYELL
Columbia University, New York, N. Y.

ABSTRACT

Two new genera, *Hollinella*, with three new species, and *Glyptopleurina*, with the genotype *G. montifera*, n. sp., are described. The genera *Glyptopleurina* and *Glyptopleura* are included in the family *Glyptopleuridae* Girty.

The Ostracoda are becoming more and more to be recognized as one of the paleontological factors of economic importance as well as of scientific interest. They are extremely useful in making correlation in the upper Paleozoic where the lithologic changes are indistinct. Each major sandstone and shale formation usually encloses a characteristic fauna of these bivalved crustaceans. The forms are small. Only occasionally is one found in well cuttings, that measures more than 1 mm. in its greatest dimension. The larger forms, if present, probably do not escape the drill.

In our work many forms have been found to be dependable horizon markers. Some are long range and some are limited to a single bed. As it is impossible now to give the entire list with figures and descriptions there have been selected for this paper a few of the most outstanding new genera and species. In the new genus *Hollinella* the species selected show the different degrees of sculpturing along the free edge. There is a decrease in the importance of the marginal ornamentation from the oldest form in the Wewoka to the youngest forms in the Francis formation. This genus according to the laws of evolution represents a group of species that have passed their zenith of complexity. The loss of characters, tending towards simplicity of structure, has indicated in other groups an approach to extinction and that trend of development is expected here among these ostracods of which *Hollinella* represents a stage.

The new genus *Glyptopleurina* is represented by only one species. It is united with *Glyptopleura* in a family, *Glyptopleuridae*.

Sincere appreciation is extended to the Pure Oil Company through whose courtesy and assistance this publication has become possible. Acknowledgement is also due to Mrs. H. N. Coryell for her assistance in preparing the sketches.

Super-Family BEYRICHEACEA

Family BEYRICHIIDAE Jones

Genus HOLLINELLA Coryell, n. gen.

Genotype *Hollinella dentata* CORYELL, n. sp.

Description.—Small, subquadrangular, equivalved, and straight hinge-lined ostracods; the surface of each valve is finely or coarsely granulose with a median sinus lying in the dorsal half, about which an irregular U shaped swelling rises; the dorsal ends of the swelling are raised into prominent lobes, the anterior one larger and more regularly hemispherical than the posterior; the free margin may be bordered with a low ridge, a broken or continuous row of spine-like extensions, or there may be no marginal ornamentation present.

Range.—Pennsylvanian.

The genus *Hollinella* includes ten undescribed species besides the three new ones described here.

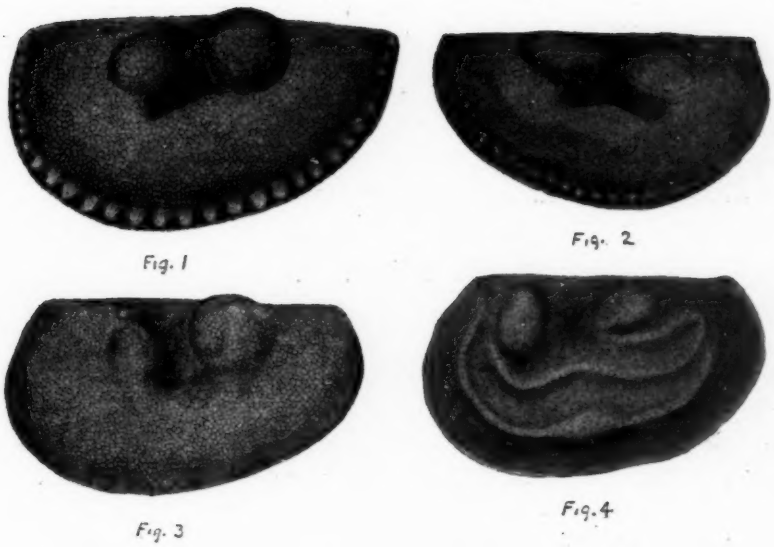
HOLLINELLA DENTATA Coryell, n. sp.

Plate 51, fig. 1

Description.—Slightly elongate, small, subquadrangular equivalved ostracods; the dorsal margin is straight with slightly angulated cardinal extremities; the free margin is paralleled by a row of conspicuous tubercular spines, the largest of which are along the ventral margin; the U shaped swelling is flush with the convexity of the surface on the ventral slope but the dorsal extremities rise into prominent lobes, the anterior one is a large hemispherical form and the posterior a low oval; the median sinus is short and deep; the surface is coarsely granulose; the greatest height lies in the posterior half of the valves; length .81 mm., height .50 mm., thickness .38 mm.

Holotype.—Columbia University Paleontological Collection No. 25202.

Range and Occurrence.—Pennsylvanian, Wewoka formation, Seminole County, Oklahoma.



EXPLANATION OF PLATE 51

FIG. 1.—*Hollinella dentata* Coryell, n. gen., n. sp. Right valve.
2.—*Hollinella ovata* Coryell, n. sp. Left valve.
3.—*Hollinella regularis* Coryell, n. sp. Right valve.
4.—*Glyplopleurina montifera* Coryell, n. gen., n. sp. Right valve.

HOLLINELLA OVATA Coryell, n. sp.

Plate 51, fig. 2

Description.—Elongate, small, equivalved, anteriorly tapered ostracods; the dorsal margin is straight; cardinal extremities are angulated; the free edge is paralleled by a low ridge, broken and tubercular in the anterior and anterior ventral portions; the dorsal ends of the U shaped ridge in each valve are raised into transversely ovate lobes; the ventral portion of the swelling is flush on the outside with the convexity of the ventral slope; the median sinus is conspicuous and lies slightly posterior to the center of the valves; the surface is granulose; the greatest height is in the posterior half of the valves; length .80 mm., height .40 mm., thickness .25 mm.

Holotype.—Columbia University Paleontological Collection No. 25203.

Range and Occurrence.—Pennsylvanian, Francis formation, Seminole County, Oklahoma.

HOLLINELLA REGULARIS Coryell, n. sp.

Plate 51, fig. 3

Description.—Elongate, small, equivalved ostracods, with forward tapering outline; dorsal margin straight; cardinal extremities angulated; anterior dorsal lobe of the U shaped swelling is a low hemispherical colline yet conspicuous; the remaining portion is inconspicuous and flush with the slope of the ventral surface of the valve except a slight rise marking the position of the posterior dorsal lobe; the median sinus and greatest height is near but posterior to the center of the valve; the free margin is without ornamentation; the surface is granulose; length .80 mm., height .45 mm., thickness .39 mm.

Holotype.—Columbia University Paleontological Collection No. 25204.

Range and Occurrence.—Pennsylvanian, Francis formation, Seminole County, Oklahoma.

Family GLYPTOPLEURIDAE Girty, 1910

Small, subquadrate, straight hinge line, unequivalved ostracods; the left valve overlapping the right; the surface is sculptured with inosculating costae, and in some forms punctae, nodes, median sinus, and marginal flange may be present.

In this family are included the genera *Glyptopleura* Girty and *Glyptopleurina* Coryell.

Genus GLYPTOPLEURINA Coryell, n. gen.

Genotype *Glyptopleurina montifera* CORYELL, n. sp.

Description.—Carapace small, subquadrate, unequivalved; the left valve overlapping the right along the free margin; hinge line straight without any apparent overlap except at the cardinal extremities where the left valve overlaps the right; dorsal contact slightly depressed; the valves are ornamented with inosculating costae, a distinct median sinus, nodes and a marginal flange; the entire surface is finely punctate.

Range.—Pennsylvanian.

This genus is distinguished from *Glyptopleura* by the presence of the nodes and flange, from *Amphissites* in having unequal valves, and from *Kirkbya* in having the left valve larger than the right.

GLYPTOPLEURINA MONTIFERA Coryell, n. sp.

Plate 51, fig. 4

Description.—Small, unequivalved, subquadrate ostracod; dorsal margin straight, with contact depressed slightly; the left valve overlaps the right at the cardinal extremities and on the free margin; the entire surface is covered with rows of fine punctae; the broad, conspicuous, dorso-medial sinus is bordered by a large node on each side; an inosculating costa extends from the posterior border of the anterior node forward, downward and backward to the posterior node, curving dorsally beneath the median sinus; ventral to this costa is another that approximately parallels the free edge and lies on the crest of the steep ventral slope; the marginal flange is narrow, corrugated and incomplete, showing most conspicuously along the postventral and posterior edges; length .90 mm., height .55 mm., thickness .41 mm.

Holotype.—Columbia University Paleontological Collection No. 25205.

Range and Occurrence.—Pennsylvanian, Boggy shale, Seminole County, Oklahoma.

MEMORIAL TO LAURA LANE WEINZIERL

On Friday, the 28th of September 1928, the Society of Economic Paleontologists and Mineralogists lost one of its charter members in the passing of Laura Lane Weinzierl. In the brief time accorded her, she had become nationally known as a Paleontologist of merit and had won a high place in the Economic branch of the profession through her work on Texas Gulf Coast problems.

She was born in Louisville, Ky., and spent her early childhood in West Texas. When seven years of age she went to Europe where she lived four years in Germany, attending her first school there. She returned to America in 1911 and lived for a time in San Antonio, and later in Los Angeles, but returned to San Antonio where she graduated from High School in 1917. In the fall of 1918 she entered the State University at Austin and in the 1919-20 term began the General Course in Geology at a time when the class was very crowded and the instructors had decided to make the work particularly difficult. At first Mrs. Weinzierl heartily disliked the subject, but was determined to come through creditably. In order to do so she was obliged to study very hard and through the serious application necessary and Dr. Whitney's contagious enthusiasm and help, she came, in the end, to enjoy this work more than any she had ever taken up, and made it her major from then on. While she was completing her third year, there were three offices in Houston experimenting with the economic value of the use of Micro-Paleontology in oil field finding and development. In order to acquaint herself with the practical details of the profession, she offered to give her services as an assistant during the summer, and the Rio Bravo Oil Company, through Mr. Dumble, was so fortunate as to be able to add her to their staff.

She served as student assistant in the Geological Department during her fourth year and on graduating in 1923, she returned to Houston and again worked in the Rio Bravo laboratory, this time as Paleontologist for Alexander Deussen, then Consulting Geologist in that city. In November 1923 he established his own laboratory and placed her in charge. Later Mr. Deussen became Vice President of the Marland Oil Company and in January 1925 she became connected with that company conducting a laboratory for them until they withdrew from the Gulf Coast. She then retained an office with Mr. Deussen and took up consulting work in which she continued until the time of her death.

On April 3, 1926, she married John F. Weinzierl, then geologist with the Marland Oil Company and later Consulting Geologist in Houston.

She was a charter member of the Society of Economic Paleontologists and Mineralogists and a member of the American Association of Petroleum Geologists, the American Paleontological Society and the Sigma Gamma Epsilon National Geological Honor Society for women. At the time of her death, she was Vice President of the Houston Geological Society.

With Mr. Deussen she published, "The Hockley Salt Dome, Harris Co., Texas", Vol. 9, No. 7, A. A. P. G. Oct. 1925; and was co-author with E. R. Applin in a paper on "The Yegua Formation of the Coastal Domes", now being completed for publication.

To those who were so happy as to enjoy her close friendship, she will always be remembered as a most plucky, cheerful, generous, and lovable personality. It was a very delightful privilege to have known her well, and also to have been associated with her in her work.

E. R. APPLIN.

JOURNAL OF PALEONTOLOGY

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